LAWRENCE W. LITTIG
PRESIDENT 1916

CAT.

TWENTY-SIXTH ANNUAL MEETING

TRANSACTIONS

OF THE

WESTERN SURGICAL ASSOCIATION

=

Twenty-Sixth Annual Meeting

St. Paul, Minnesota, December 15 and 16, 1916

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OFFICERS AND EXECUTIVE COUNCIL, 1917

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CHAIRMAN COMMITTEE OF ARRANGEMENTS

Byron B. Davis, M. D. - - - - - Omaha

EX-PRESIDENTS AND MEETING PLACES

PRESIDENT	PLACE	YEAR
S. S. Todd*	Topeka	1891
Milo B. Ward*	Kansas City	1892
Milo B. Ward*	Des Moines	1893
Lewis Schooler	Omaha	1894
John E. Summers, Jr.	Kansas City	1895
Thomas J. Beattie	Topeka	1896
Joseph Eastman*	Denver	1897
David S. Fairchild	Omaha	1898
Homer C. Crowell	Des Moines	1899
O. Beverly Campbell	Minneapolis	1900
August F. Jonas	Chicago	1901
James E. Moore	St. Joseph	1902
Alex. Hugh Ferguson*	Denver	1903
Charles H. Mayo	Milwaukee	1904
Harvey D. Niles*	Kansas City	1905
Malcolm L. Harris	Salt Lake City	1906
Charles W. Oviatt*	St. Louis	1907
William W. Grant	Minneapolis	1908
Arthur L. Wright*	Omaha	1909
John P. Lord	Chicago	1910
Amos W. Abbott	Kansas City	1911
Lewis L. McArthur	Cincinnati	1912
Jabez N. Jackson	St. Louis	1913
Byron B. Davis	Denver	1914
Joseph Rilus Eastman	Des Moines	1915
Lawrence W. Littig	St. Paul	1916

*Deceased.

The Western Surgical Association does not hold itself responsible for, or necessarily endorse, any of the papers printed herein.

ARTHUR T. MANN, Secretary-Treasurer.

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Executive Session

TRANSACTIONS OF THE W. S. A.
EXECUTIVE SESSION

December 15, 1916—First Day—Morning Session

The Association met at the Minnesota Club, St. Paul, Minn., and was called to order at 9:30 a. m. by the President, Dr. Lawrence W. Littig, Davenport, Iowa.

Dr. E. P. Quain, of Bismarck, read a paper on "A New Instrument for the Application of the Sewing-Machine Stitch in Gastro-intestinal Anastomoses," which was discussed by Dr. Collins, and, in closing, by the essayist.

Dr. Arnold Schwyzer, of St. Paul, read a paper on "A Simple and Efficient Suture for Fatty or Infected Abdominal Walls," which was discussed by Drs. Dennis, Byford, Harris, and, in closing, by the essayist.

Dr. Byron B. Davis, of Omaha, read a paper entitled "Perforating Gastric and Duodenal Ulcer."

Dr. Donald C. Balfour, of Rochester, Minnesota, followed with a paper on "The Results of Surgical Treatment of Gastric Ulcer."

The two preceding papers were discussed by Drs. Collins, Coffey, Haines, MacLaren, Freeman, Harris,

Pearse, Van Buren Knott, Wetherill, Littig, and the discussion was closed by the essayists.

Dr. Horace G. Wetherill, of Denver, moved that members of the profession not members of the Association be extended the courtesies of the floor. Seconded and carried.

Dr. Warren A. Dennis, Chairman of the Committee of Arrangements, announced that the sessions of the Association and the banquet would be held at the Minnesota Club, and that at the banquet the address of President Lawrence W. Littig would be delivered, and also an address by Dr. Fred H. Albee, of New York City, on "Experiences in War Surgery in France, with Motion Pictures."

Dr. Frank J. Corbett, of Minneapolis, read a paper on "Peritoneal Adhesions."

Dr. Arthur E. Hertzler, of Kansas City, read a paper entitled "Factors Which Determine the Extent and Duration of Peritoneal Adhesions."

The two preceding papers were discussed by Drs. Quain, Byford, Freeman, Mann, and, in closing, by the essayists.

On motion, the Association adjourned until 2 P. M.

First Day—Afternoon Session

The Association reassembled at 2 P. M., and was called to order by the President.

Dr. Samuel Goodwin Gant, of New York City, read a paper on "Misconceptions of Surgeons Concerning Rectocolonic Affections," which was discussed by Drs.

Wetherill, Mayhew, and, in closing, by the essayist.

Dr. R. C. Coffey, of Portland, Oregon, read a paper on "The Two-Stage Operation in Abdominal Surgery," which was discussed by Dr. Dean Lewis.

Dr. Willard D. Haines, of Cincinnati, read a paper on "Some Features in the Management of Osteomyelitis."

Dr. Emil G. Beck, of Chicago, read a paper entitled "The Radical Cure of Osteomyelitis by Skin-Implantation into Bone Cavities, with the Adjunct of Adhesive Plaster to Produce Epithelization of Raw Surfaces, with Demonstration of Patients."

The two preceding papers were discussed by Drs. Colvin, Davis, Griffith, Pearse, Basham, Murphy, Jackson, Percy, Lewis, Mann, Binnie, Harris, and discussion closed by the essayists.

Dr. A. L. Blesh, of Oklahoma City, read a paper on "A Method for Closing Large Rectovaginal Fistulæ," which was discussed by Drs. Ritchie, Hertzler, Souther, Abbott, Evans, and, in closing, by the essayist.

Dr. Oliver J. Fay, of Des Moines, read a paper entitled "Traumatic Surgery of the Liver," which was discussed by Drs. Hill, Cubbins, Fairchild, Murphy, Coughlin, Hertzler, Basham, Benjamin, Pearse, and, in closing, by the essayist.

Dr. Roland Hill, of St. Louis, read a paper entitled "Posture in Cases of Abdominal Drainage," which was discussed by Drs. Coughlin, Nifong, Sweetser, Benjamin, Coffey, and, in closing, by the essayist.

On motion, the Association adjourned until 8 P. M.

First Day—Evening Session

At this session (the annual dinner) President Dr. Lawrence W. Littig, of Davenport, delivered his address, entitled "The Open Hospital."

Dr. Littig was followed by Dr. Fred H. Albee, of New York, who narrated his experiences in war surgery in France, with motion pictures.

Adjourned.

December 15—Second Day—Morning Session

The Association met at 9 a. m., and was called to order by the President.

Dr. Horace G. Wetherill, of Denver, read a paper on "The Balance of Power in Infection," which was discussed by Drs. Beck, Haines, Griffith, and, in closing, by the essayist.

Dr. Fred T. Murphy, of St. Louis, read a paper on "Treatment of Lacerated Wounds," which was discused by Drs. Clopton, Hopkins, Beck, Byford, Lemon, Pearse, and, in closing, by the essayist.

Dr. Charles H. Lemon, of Milwaukee, read a paper entitled "Serous Meningitis Following Traumatism," which was discussed by Drs. Halstead, Yates, Dunsmoor, Ghent, and, in closing, by the essayist.

Dr. William T. Coughlin, of St. Louis, read a paper entitled "Ligation of the Innominate Artery After the Removal of the Upper Part of the Sternum," which was discussed by Drs. Hill, Schwyzer, Lord, Haines, and, in closing, by the essayist.

Dr. John E. Summers, of Omaha, read a paper entitled "Cardiolysis: A Further Report with Notes upon an Additional Case," which was discussed by Drs. Coffey, Cubbins, Gray, and, in closing, by the essayist.

Dr. John P. Lord, of Omaha, read a paper on "Conservative Surgery of the Feet, with Report of a Case," which was discussed by Dr. Pearse.

Dr. Arthur F. Holding, of New York City, read a paper on "Radium, *X*-Ray and Coagulation Methods."

Dr. Leonard Freeman, of Denver, read a paper by Dr. Casper F. Hegner, Denver, Colorado, on "Lightning: Some of Its Effects, with Report of Two Cases," after which, on motion, the Association adjourned until 2 P. M.

Second Day—Afternoon Session

The Association reassembled at 2 P. M., and was called to order by the President.

Dr. A. J. Burge, of Mason City, read a paper on "Report of Two Cases of Malignant Cervical Tumors Arising from the Carotid Body," which was discussed by Drs. Moore, Binnie, Percy, Coughlin, and, in closing, by the essayist.

The President: We will now listen to the report of the Secretary-Treasurer.

The Secretary-Treasurer presented the following report:

Report of the Executive Council

There were present at the meetings of the Executive Council, Drs. Littig, Harris, Davis, Jackson, Freeman, Knott, and Mann.

The following are recommended for membership:
Cochran, Guy—Los Angeles, Calif.
Corwin, Richard W.—Pueblo, Colo.
Cottam, Gilbert G.—Sioux Falls, S. Dak.
Franklin, John H.—Spring Valley, Ill.
Harsha, Wm. M.—Chicago, Ill.
Hopkins, C. W.—Chicago, Ill.
Horton, Geo. M.—Seattle, Wash.
McKinnie, Lewis H.—Colorado Springs, Colo.
Richardson, Witham W.—Los Angeles, Calif.
Robinson, Samuel—Rochester, Minn.
Smith, Rea—Los Angeles, Calif.
Speed, Kellogg—Chicago, Ill.

The following are recommended as nominees for the Board of Governors of the American College of Surgeons:
M. L. Harris.
J. N. Jackson.
H. G. Wetherill.

The following are recommended as officers for the coming year:
President—Leonard Freeman, Denver.
First Vice-President—Joseph Ransohoff, Cincinnati.
Second Vice-President—Roland Hill, St. Louis.
Secretary-Treasurer—Arthur T. Mann, Minneapolis.
For the Executive Council:
Jabez N. Jackson.
Van Buren Knott.
The Treasurer's Report was approved, and is as follows:

The Treasurer's Report

RECEIPTS

Balance on hand December 18, 1915	$ 202.25
Fees and dues to December 15, 1916	1,370.00
For three volumes of Transactions	7.50
Extra tickets at banquet and amount due	100.70
Total	$1,680.45

DISBURSEMENTS

Paid Wm. Whitford for reporting the Des Moines meeting	$158.49
Exchange on checks	1.30
250 vols. Transactions and cuts	783.92
Printing	87.30
Buttons	27.00
Postage and express	24.15
Banquet and accessories	452.19
Honorarium to Secretary	100.00
Lantern two days	20.00
Total	$1,654.35
Balance on hand	26.10

As the place of meeting next year, Omaha, Neb., is recommended, with Byron B. Davis as Chairman of Committee of Arrangements, and the date, Friday and Saturday, December 14 and 15, 1917.

THE PRESIDENT: What will you do with this report?

DR. JOHN P. LORD: I move that it be adopted as read. Seconded and carried.

DR. HORACE G. WETHERILL: I desire to introduce the following resolution:

In appreciation of the great courtesy and many kindnesses heaped upon us by Dr. Warren A. Dennis, Chairman of the Committee of Arrangements, and the surgeons of St. Paul, and in grateful acknowledgment of the generous hospitality of the Minnesota Club, be it,

RESOLVED, that the Western Surgical Association hereby thanks these bountiful hosts for the delightful entertainment accorded us at this meeting.

We shall return to our homes filled with happy memories of the occasion and with pleasurable gratitude to all who have contributed in any way to our comfort and enjoyment.

I move the adoption of this resolution.

Seconded and carried.

THE PRESIDENT: Last year a committee was appointed on Preparedness. Dr. S. C. Plummer, of Chicago, was appointed chairman of that committee, and we will now listen to a report from him.

Before reading the report Dr. Plummer said:

Dr. Bloodgood asked that the Association appoint an advisory committee on first aid to make a report, setting forth the feeling of the Association in regard to the matter of first-aid standardization.

Your committee was duly appointed, and made its report, a copy of which was sent to the secretary of the first-aid conference, Dr. Bloodgood, and also a copy was sent to the secretary of the Board of Standardization, Dr. Rucker. Since this report was sent in there have been developments which greatly lessen the value of the report. At that time, the Board of Standardization had no appropriation of any kind to pay for printing or postage, or anything of that sort, and it was desired to get reports of this kind from as many associations as possible and from state and district societies. Fortunately, however, during the year the Board succeeded in getting under the wing of the Department of Labor, where there was some available money. and they succeeded in getting an appropriation, so that they have been able to go into this thing in a much more thorough manner, the plan being to get out a questionnaire embracing the different points which the Board wishes to pass upon, and they have already sent this questionnaire to every surgeon in the country they can reach, with the request that the surgeons fill it out and return it. I would earnestly ask every member of the Association to fill out that questionnaire, and return it to Dr. Rucker. It has sixty questions, and it will take an hour or two to fill it out. I think it is worth while, and it is a patriotic duty to do this because the Board wishes to make a report in regard to standardizing first aid instruction, and first-aid packages, which will reflect the opinion of the profession of the country at large, because, if it does so reflect it, it will be accepted, otherwise it will not.

I will now read the report of your committee.

Dr. Plummer then read the following report:

MEETING OF COMMITTEE ON FIRST AID OF THE WESTERN SURGICAL ASSOCIATION

On February 4, 1916, the Committee on First Aid of the Western Surgical Association met in Chicago. There were present Drs. M. L. Harris, of Chicago, Donald Macrae, of Council Bluffs, A. N. Collins, of Duluth, and S. C. Plummer, of Chicago, Chairman. Dr. J. R. Eastman, of Indianapolis, was prevented by illness from attending.

DEFINITION OF FIRST AID

The Committee first took up the meaning of *first aid,* as in its opinion it ought to be understood in specifying the scope of first aid, as considered by the Board of Standardization. The opinion of the Committee was that "first aid" means first aid as taught to and applied by the laity.

The following definition of first aid was suggested by Dr. M. L. Harris, of Chicago, and endorsed by the Committee:

"By 'first aid' is meant the services rendered by any one to another in distress, the result of sudden illness or injury, pending the placing of the patient in a position to receive definitive treatment for his condition, should such treatment be necessary."

It was the sense of the Committee that the Board ought to consider both the First-Aid Package and also the question of instruction to the laity.

FIRST-AID PACKAGE

It was the sense of the Committee that the most desirable first-aid package would be one which was simplest.

In the opinion of the Committee the contents should consist of gauze, bandages, and safety-pins.

In addition to the above contents, for military purposes may be added such articles as may be deemed necessary or advisable by army surgeons.

It is the opinion of the Committee that the first-aid package should contain no chemicals.

INSTRUCTION OF THE LAITY

It is the opinion of the Committee that the elementary principles of first aid should be the basis of instruction to the laity.

We believe that the teaching should begin in the schools and should be carried on in the universities.

We believe that the teaching should be extended to all classes of society.

In the case of the various industries, we believe that the teachings should be adapted to the particular needs of each industry.

ADDITIONAL AID IN MILITARY PRACTICE

In military practice we realize that the conditions are different from those in civil practice, and, in view of the conditions known to exist in the present European war, we would suggest that wounds receive further attention which might be called "second aid" before being transferred to the base hospital. We have in mind especially the incision of wounds containing infected foreign material.

THE PRESIDENT: What will you do with this report?

DR. W. D. HAINES: I move its adoption.

Seconded and carried.

THE PRESIDENT: I will ask Drs. Wetherill and Percy to escort the newly elected President, Dr. Freeman, to the rostrum.

THE PRESIDENT: It is hardly necessary for me to introduce to you Dr. Freeman at this time. (Applause.)

DR. FREEMAN, in accepting the Presidency, said:

Words will be few. Fortunately, I am not expected to say much at this time, but what I do say comes from the bottom of my heart because this is one of the best things that ever happened to me in all my life. I should be very proud to be president of any surgical association, but I am particularly proud to be elected president of the Western Surgical Association because the West represents all that is good and mighty in the surgery of this continent today. The West is the red blood, as it were, of surgery, and our young men are the circulating red-blood corpuscles that keep the thing alive, and

the Western Surgical Association is the heart that keeps these red-blood corpuscles going.

I feel that our meetings in the past have been good; I feel that our meeting now is most excellent; and it shall be my duty, as far as it lies in my power, to see that the next meeting, if possible, is better than this one.

I thank you most heartily. I feel this honor most deeply.

(Applause.)

Dr. Herman E. Pearse, of Kansas City, read a paper entitled "Adrenal Cysts, with Report of Two Cases."

Dr. Charles D. Lockwood, Pasadena, read a paper on "Surgical Treatment of Banti's Disease, with Report of Three Cases," which was discussed by Drs. Balfour, Cubbins, Davis, Yates, Harris, and, in closing, by the essayist.

Dr. E. Starr Judd, of Rochester, Minnesota, read a paper on "Intracanalicular Papilloma."

Dr. James F. Percy, of Galesburg, read a paper on "A Technic for the Radical Cautery Operation in Breast Carcinoma."

The two preceding papers were discussed together by Drs. Judd, Quain, and, in closing, by Dr. Percy.

Dr. John L. Yates, of Milwaukee, read a paper on "Surgical Methods in the Treatment of Malignant Affections in Superficial Lymphatic Tissue," which was discussed by Drs. Judd, Harris, and Holding.

Dr. A. E. Benjamin, of Minneapolis, read a paper entitled "Thyroid Disease, with the Present Method of Operative Procedures," which was discussed by Drs. Schwyzer, Freeman, and, in closing, by the essayist.

The scientific program having been completed, the retiring President, Dr. Littig, said:

Members of the Western Surgical Association: It gives me great pleasure to transfer this gavel to so worthy a man as Dr. Freeman. I assure him that there is before him a most pleasant experience. I am sure, however, that he will not receive more gracious coöperation than that which has been accorded me during the past twelve months. Whatever merit this program may have possessed, it is entirely due to Dr. Mann, our efficient Secretary, and I wish to make this public acknowledgment that he has done much of the work for which he does not receive full credit.

One thing has been especially apparent to me during the past few days, and that is, every one has contributed to the success of this meeting either by a paper or discussion or by his presence. (Applause.)

As there was no further business, scientific or otherwise, to come before the meeting, on motion, the Association adjourned to meet in Omaha, Nebraska, December 14 and 15, 1917.

President's Address

SOME HOSPITAL PROBLEMS

L. W. Littig, A.M., M.D., M.R.C.S., F.A.C.S.

DAVENPORT, IOWA

I feel that I should be unresponsive did I not, at the very outset, give voice to my appreciation of the honor conferred on me one year ago, the highest and most prized in your power to bestow.

The Western Surgical Association includes among its members many men whose ability, attainments, and service so far surpass my own that I have always considered membership in this Association a high honor and a precious privilege. To have been the standard-bearer for one year will ever remain a pleasant and cherished memory. To transfer the banner to my successor, its luster undimmed, has been considered a sacred obligation. Not to disappoint those most responsible for my present position, has been my great concern and constant effort.

I approached the duties and responsibilities of my position with misgivings anything but faint, to find them vanish in thin air before the whole-souled and most gracious coöperation, I should say guidance, of Secretary Mann, to whose efforts the program is an eloquent testimonial. Without exception, there has been everywhere manifested the sentiment wafted northward from the shores of the great Missouri. It came in these words: "If there be anyone for whom I

would take off my coat and work, it is you." I read the strengthening words a second time, and substituted "Western Surgical" for the personal pronoun in the second person, and I know that, with this change, the sentiment is shared by every member of this organization. The letter was signed "Hertzler." God bless him! May his years be many and happy! Like Toiling Felix of Van Dyke, like you, and like me, he has—

"Felt the brotherhood of labor rising round him like a tide,
"Overflow his heart, and join him to the workers at his side."

It is this feeling, this brotherhood of labor, which has endeared the Western Surgical Association to everyone fortunate enough to be a member, and which makes its inspirations more than purely scientific,—an organization which every member loves, and for which he is ever ready to take off his coat and work.

I have selected for brief discussion a subject which I consider of immense importance, and which promises a far-reaching influence for good in the practice of both medicine and surgery. I refer to the investigation and classification of hospitals as now proposed by several powerful agencies.

It has often been said that never before, in the history of the world, have there been so many good surgeons, never has surgery been so well done, never have the results been so brilliant. Equally true, I believe, is the following: Never, in the history of the world, has there been so much ill-advised operative interference, never have the results been so disastrous.

Of all the factors that make for good surgery, the modern, well-equipped, well-managed hospital takes first rank. Here is found every aid and incentive to better and yet better work.

But the hospital, well-equipped as it may be in things material, that places its wards and its operating-rooms at the disposal of all alike, is not only poor, indeed, but is an actual menace to the community in which it is located. I refer to the open hospital as usually conducted in communities of from three thousand to one hundred thousand inhabitants. Any criticism or suggestion I may make will be confined to hospitals of this class, and will not refer to large city hospitals, or to hospitals connected with medical schools.

The hospital I have in mind permits every practitioner of medicine so desiring to assume the gravest responsibilities within its walls, places at his disposal all of its facilities, and even provides for him a camera obscura in which he is invited to work, and which protects both him and the hospital from criticism and, too often, from well-merited censure. The greatest sins are committed in the name of surgery. While it is true that the internist must face the most difficult and perplexing problems, yet there will always remain this great difference between the internist and the surgeon. It is incredible that the internist should be an active agent in causing unnecessary deaths or permanent invalidism. At most, his sins are those of omission, while those of the operator too often are the sins of commission. Of the good done by surgery, I shall say nothing. Of the harm done in the name of surgery, there is no need to say much. How often have you listened to the pathetic story of repeated operations, the first probably unnecessary, or poorly done, or wide of the mark, with a progressive aggravation of symptoms! You have all listened to the pitiable tale of the young married woman, her pelvis "cleaned out" by some operator. The hundreds in untimely graves remain silent. The open hospital is responsible

for most of the malpractice done in the name of surgery. How is good work possible in the average open hospital? I know one such hospital with fifty beds, to the wards and operating-rooms of which one hundred general practitioners of medicine have the privilege of bringing their patients. My informant reported this particular hospital as a closed hospital. When asked to name one doctor within a radius of twenty-five miles that is denied the privileges of the hospital, he was unable to do so. He compromised by insisting that the hospital is not wide open, although he did not explain how it could be opened wider. That all the doctors in a given community are doing good work, within or without a hospital, is not claimed by anyone.

It has been said that "the staff makes the hospital," or, "as is the staff, so is the hospital." These statements, while practically true, do not apply to the open hospital, because most open hospitals either have no staff at all, or a nominal staff that meets "once in ten years," or "when a row is on," or "it is hit or miss." The great characteristic of the usual open-hospital staff is an all prevading inertia, the most effective barrier to progress, and an utter failure to grasp the prime function of a hospital staff.

I quote from a recent paper by myself, written after investigating the hospital situation in a mid-western state:

What is the chief function of a hospital staff? The answer is very simple. The chief function of a hospital staff is to educate itself, individually and collectively, to better discharge the duties and obligations incurred by its members in accepting staff appointments. To serve its purpose, a staff must hold frequent meetings, at which, not only hospital problems, but more especially medical problems must be discussed, interesting cases must be presented for consideration. As failures are often more instructive than successes, these should be reported for free discussion. It is especially important that the causes of "accidents" be thoroughly investi-

gated and the responsibility fixed. Staff members should make frequent visits to medical centers, and every member making such a visit should bring back with him, for the benefit of his fellows, whatever is worthy of presentation.

The operating-room should be open to staff members and assistants at all times, and all operations should be bulletined.

A weekly staff conference should be the rule in every hospital. As many members as possible should be invited to study interesting cases in the wards. Necropsies should be bulletined, and pathological specimens carefully studied. In this way the experience of each staff member will become very considerable.

It might be well for the staff to organize itself into a current medical literature club, to better keep abreast of the times, and also to have its members present synthetic reviews on this or that topic, thus taking an active part in medical-society work. With the improvement of the staff individually and collectively as the prime motive in staff organization, increased staff and hospital efficiency, and better service to the patient will be sure to come.

All this may seem very elementary to those of you connected with great teaching and research hospitals, yet I failed to find one open hospital in the "Mid-West" in which the staff either realized its opportunities or profited by them, along the lines suggested. Real progress will not be possible in the hospitals under consideration until staff members realize their delinquency, and become fired with a desire and an ambition to improve themselves, and to do better work. To feel the spirit of progress, and to feel the need of improvement, are the all-important first steps that will lead to better things. But, unfortunately, this spirit is still unborn in the great majority of open hospitals in the Middle West.

The introduction of a very good *x*-ray apparatus, and the establishment of passable clinical laboratories have acted as soporifics rather than as stimulants. It matters not that the *x*-ray plates, even in bone cases, have read into them whatever the fancy of the am-

bitious operator may suggest, or that the laboratory reports are very amateurish or their interpretation anything but correct. Only recently I heard the president of a county medical society, in his retiring address, make the following statement: "With the *x*-ray and the laboratory, we are all equal; all of us can do our own work, consultants are no longer necessary."

Nothing can be hoped from men that blindly follow laboratory diagnoses, instead of doing some hard, independent thinking themselves. The day has not yet arrived, and never will arrive, when the *x*-ray and the laboratory will make all men equal.

The evils of the present-day open hospital do not appear to be self-limited; there is no promise that they will be corrected from within; their eradication seems to demand some powerful influence from without. Publicity is the only efficient weapon. Once fully cognizant of the relative merit of different available hospitals, the public will make its influence sharply felt, to the advantage of the better hospital. If the hospitals of a given community are not high grade, the sick of that community, whenever possible, will seek relief in better hospitals, wherever they may be.

That the public is taking notice is evidenced by the following unique situation in at least one Mid-Western community. A religious organization built a hospital, accepting contributions from near-by practitioners with the distinct understanding, it is said, that the hospital would be open to all physicians alike for the care and treatment of patients. One of the contributing near-by practitioners, again, "it is said," made a contribution so much larger than any of the others that he was elected surgeon to the hospital, the surgical patients of the other practitioners not being accepted unless the hospital surgeon assisted at the operation, and received half of the fee. The hospital manage-

ment, appealed to by the disconcerted practitioners, sustained the hospital surgeon. The courts will now be asked to decide whether a hospital board, after acception contributions with the understanding that all practitioners be accorded equal privileges, may select one man to do all the surgery.

A very successful hospital in one of the old Middle States pays its surgeon a fixed salary per year; he resides in the hospital, and does all the general surgery.

These two instances are the very antitheses of the open hospital. They may be undemocratic, they may not promise the best for either the profession at large or for the general public, but somewhere between them and the wide-open hospital there will be found a plan which, on the one hand, will give every properly trained and right-minded man an opportunity to work out his destiny, and, on the other, will aid him to protect the community from the assaults daily committed in the name of surgery. The open hospital must be transformed into a restricted hospital, and by a method eminently fair, something like the following: When a properly trained, but untried, licensed practitioner wishes the operating-room, the answer will be: "Yes, but like every other man operating in this house, you must bulletin your operation the evening before. The superintendent of the hospital and one or more staff members may be present. You are on trial, but, so long as you have any privileges here, you will have all the privileges. You are welcome in the operating-room when others operate, and at the clinical conferences of the staff. If your work is satisfactory, you may come again, and after a few years you may be elected to staff membership; but, if your work is not satisfactory, why, we shall regretfully inform you that we have no unoccupied beds. This is not a closed hospital, but it is a restricted hospital."

I believe that the remedy is in sight and that the next few years will witness much better work done in the type of hospital under consideration. The agencies that will bring about the desired change are several. As stated above, publicity is the most efficient weapon. A hospital management or a hospital staff which fails to react to ordinary stimuli will very promptly take notice when the standing of the hospital in the community is menaced. Investigation and classification of hospitals, as planned by the American College of Surgeons, promises splendid results. I know that even the possibility of such action by the College has been productive of good.

There is another agency which cannot fail to make its influence felt, perhaps even more sharply than the College of Surgeons. I refer to the hospital fifth year, soon to be required by both medical schools and state examining-boards. Minnesota, Pennsylvania, New Jersey, North Dakota, Illinois and Rhode Island have already taken definite action. This hospital fifth year will not only have a beneficent influence on the candidate for the degree and for the state license, but will make it necessary for both medical schools and state boards to know whether the work done in a given hospital entitles it to recognition. The schools and the state boards must investigate the hospitals seeking internes. These keen-eyed young internes will report back to the medical school, and, possibly, to the state board. Their influence on the hospital will be most salutary.

But many hospitals of the Middle West do not employ internes, and these will not be influenced by the hospital fifth year or by the medical schools. The College of Surgeons can reach them, but there is one other opening which will enable state boards to investigate and largely control them. All of these hos-

pitals have training-schools, and every graduate of the training-school must present herself before the state board for examination to secure her certificate of registration. This gives the board the opportunity and the right to acquaint itself with the work done in the school, to know whether the young women seeking recognition have been properly instructed, or whether they have been chiefly useful as revenue-producers, by being assigned as special nurses to private patients at fifteen or twenty dollars a week, and this while still on probation. I have known this to be done, not once but repeatedly. I have known a young woman to write her parents during the third month of her training, while still a probationer, that she was getting along famously, having been assigned to "special" duty—and all this in a hospital pretending skilled service to the sick, but really conducting its training-school for revenue.

I should like to say: "As is the training-school, so is the hospital," because a good training-school in a poor hospital is unthinkable, and the converse holds equally true. The state boards cannot classify hospitals, because the friends of a discredited hospital would immediately rise in arms, would term the action of the board arbitrary and unfair, and would soon set in motion political machinery very embarrassing to the board, or to those members of the board considered responsible. But the board can inspect the training-school, and carefully examine all applicants for state license. Should candidates be sent back for three or six months' additional preparation, neither the hospital itself nor its friends could protest without directing attention to the shortcomings of the training-school.

While about training-schools, it sometimes happens that a young woman, early in her course in training,

comes to a realization of the fact that the instruction she is receiving is very far from satisfactory. But let this same young woman try to gain admission to some other school, even if willing to forfeit the time already spent in training! She will apply to many schools before attaining her object, if she succeed at all. She will be requested to present a satisfactory certificate from the head of the school in which she is a pupil, and begin again as a probationer. The second requirement is not so objectionable, in fact, in many cases it is entirely reasonable, but an "honorable discharge" is not always to be had for the asking. The candidate for admission to the training-school is on trial for three months, and at the end of this time she may be received or she may be sent away. Would it not be fair that she be given a certificate at this time, stating that her probationary period has been satisfactory, she to have the same option, to remain or to seek training elsewhere? These credentials might not be accepted by other schools, but they would be equivalent to an "honorable discharge," and would enable her to enter another school without being required to ask her principal for a certificate of character and class-standing, very difficult to obtain should work be crowding and nurses none too plenty or an exodus of nurses feared. More likely, she would be branded as a disloyal discontent, and the desired credentials refused. To be accused of disloyalty and discontent covers a multitude of virtues—in a training-school pupil.

It is manifestly unfair to compel an inexperienced but intelligent young woman to spend three years in an inferior school just because she made a poor selection at the outset. The present arrangement is very much in favor of the poorer hospitals and poorer schools. Their pupil nurses simply cannot get away, even when willing to forfeit all the time already spent

in training. At my request, a young woman wrote twenty-five letters to as many different hospital training-schools, asking for admission, and stating that she had spent one year in a local school, but that she felt that she was not receiving the training she desired. Twenty-five replies were received, but not one school would accept her. The usual answers were "We do not accept pupils from other schools"; "We will not consider your application at all so long as you are in another school"; or "You must first secure an honorable discharge from the school you are now attending." In no school would there be a vacancy for months. She had started wrong, and there was nothing to do but remain where she said she had begun. Only a few days ago, a hospital director, a physician, expressed himself on this same point. He said: "The record and standing of every nurse ought to be in writing, and given her whenever desired. As matters now stand, the intelligent, ambitious girl that comes to a realization of the fact that the training she is receiving is very inferior, will not be received by another school, as the necessary papers will most likely be denied her, especially if other trainers are apt to follow."

In this great democratic country of ours, only the young woman in a training-school is subjected to such thraldom. It is not fair. Of all women, none are quite so helpless as the pupil in a training-school. Of all women, few are more autocratic than the average head of that same training-school; few more relentless. It is time that a more liberal spirit make itself felt in behalf of the young woman in training. The American Hospital Association might well consider this matter.

In closing: The investigation and classification of hospitals by the College of Surgeons, by medical schools, and by state boards, and by the careful investigation of training-schools by state boards—these

are the agencies that will make for better service in hospitals.

To the above there must be added a most wholesome sentiment inculcated by leading medical men. Only recently I heard, in a Chicago clinic, a most refreshing statement by the teacher. He said: "We do not want our graduates to consider themselves specialists, we do not care to have them know how to do a given operation, but we want them to recognize surgical conditions, we want them to know how to make a diagnosis. If they wish to be surgeons, we want them to take additional training." There is a world of promise in words such as these. Young men taught in this manner must have a finer conception of their responsibilities.

In regard to the education of the surgeon, I wish to endorse all that has been said by Finney, Haggard, Jackson, and others, but I wish to emphasize especially conscience and honesty, not that these two very essential attributes have been passed over lightly by any of the gentlemen named, but because they cannot be mentioned too often. No matter what his professional qualifications, the surgeon without conscience and honesty is poor, indeed.

A NEW INSTRUMENT FOR THE APPLICATION OF THE SEWING-MACHINE STITCH IN GASTRIC AND INTESTINAL SURGERY

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The proper application of suture technic for the purpose of anastomosis and for the closure of incisions into the stomach or bowel, is one of the essentials for successful gastric and intestinal surgery. We must have a method which prevents leakage of the visceral contents, consumes the shortest amount of time, and assures absolute hemostasis. Of these three requirements the last is of the greatest moment. Quickness of application is always desirable, but it must not go beyond a point of safety, and may not be a vital question, except on rare occasions. Prevention of leakage, after the first few hours, is aided effectively by plastic adhesions of the serosa. Hemostasis, on the other hand, must be immediate and as near the absolute as possible; otherwise the patient's life is jeopardized by inefficient technic from the very time of operation. My own experience, and conversations with other surgeons, have convinced me that none of our older suture methods are invariably satisfactory with respect to the problems mentioned above. It may be a confession of weakness in the art of suturing to admit that we have seen hemorrhage follow what was considered a

perfect application of a Connell continuous suture, yet the confession must be made out of true interest in our art.

In order that a suture be absolutely hemostatic it is necessary that it comprise and compress every part of the incised tissues. A discussion of the various suture methods possible for the accomplishment of this aim is not the object of this paper. Its purpose is to call attention to the use of the double, interlocking, through-and-through, running suture, best illustrated by the stitch made by the ordinary sewing machine in sewing two edges of cloth together. The sewing-machine needle differs from other sewing needles by having its eye near the point. When the needle is pushed through the cloth the point carries a loop of thread immediately to the opposite surface of the material. The shuttle passes through the loop, the needle is withdrawn, and the upper and lower threads are interlocked within the opening made by the needle. A succession of stitches makes a firm compression on all fibers of the material between the stitches. It is evident that wherever this type of suture can be applied tightly to any living and bleeding tissues there will be a uniform compression of all structures of this tissue, and hemorrhage distal to the suture-line cannot take place.

In order to make a practical application of this principle in gastric and intestinal surgery, the writer found it necessary to devise a needle after the type of the one on the sewing-machine. Numerous models have been made (by V. Mueller & Co.), but it is believed that the one now demonstrated will be found most satisfactory for the work mentioned. (Fig. 1.) The needle is round and slightly curved toward the point. An eye large enough to carry a No. 2 chromic catgut is placed about one-fourth of an inch from the point. The convex border of the needle is grooved from the

eye to the handle so that when the needle is threaded the catgut lies within the shaft between these two points. The base of the point near the eye has a slightly greater diameter than the shaft immediately above the eye, in order to make the opening through the tissues large enough to accommodate the passage of the catgut resting on the concave side, without tearing. The upper end of the shaft ends in a flattened handle, making the entire instrument above five inches long. A tension-spring is placed on the handle so as to hold the catgut taut and to allow its ready release as the stitching progresses. The other end of the catgut is fastened to another needle, which takes the place of the "shuttle" in the sewing-machine. A Hagedorn, or an ordinary darning-needle, may be used for this purpose. It was found, however, that a small hook near the point is a great convenience for picking up the catgut loop from the concavity of the other needle, and a special crochet-hook "shuttle" needle was therefore made for this purpose.

The technic for making a gastro-enterostomy as now practiced by the writer may be described as follows: The stomach and jejunum are first approximated by the usual serosa-to-serosa suture, the incisions are made, and spurting vessels are clamped temporarily. The hemostatic suture is then begun with the special needle threaded with a twenty-four inch long No. 2 chromic catgut at the side nearest the operator. The point is introduced from inside the bowel and in line with the long axis of the incision so as to emerge on the serosa about one-fourth of an inch from the angle. (Fig. 2.) The needle is then made to penetrate the stomach wall at the corresponding point from its incision. It is pushed just far enough into the stomach to allow the "shuttle" needle, fastened to the other end of the catgut, to pass through

the loop picked up by the hook near the eye of the other needle. (Fig. 3.) By withdrawing the needle and making an even pull on the two ends of catgut, the first stitch is pulled tight. Care should be exercised that this stitch is located near the middle of the catgut, and the length of catgut between stitch and needle should be kept about three inches. This process is repeated, making a series of stitches of suitable length (about three-sixteenths of an inch) until the middle of the posterior suture line is reached. (Fig. 4.) Here the catgut is pulled up tight and tied over the mucous membrane margins in order to prevent slipping and loosening up of the even pressure. After tying this knot it is necessary to resume the stitching at least as far back on the suture line as where we left off the last stitch before tying the knot. (Fig. 5.) Unless this is done there will be a section of unsutured tissue immediately under the knot. This point should be kept in mind every time the catgut is tied over the edges of the mucosæ. When the farther angles of the incisions have been reached, the ligatures are again tied. From now on a slightly different technic becomes necessary. The point of the needle is passed from inside the jejunum up through its serosa, then brought across to the gastric margin, which is penetrated from serosa to mucosa. (Fig. 6.) The catgut loop is picked up with the "shuttle" needle on the gastric mucosa, and a perfect serosa-to-serosa approximation can be seen to take place. (Fig. 7.) The stitching is continued in this fashion, with one or two knots for fixation, until the wound is so nearly closed that it becomes difficult to pass the needle from within the lumen of the viscus. The catgut is then pulled taut and tied. The remaining gap, a half an inch or less, can be closed with the same continuous suture by two through-and-through stitches as follows:

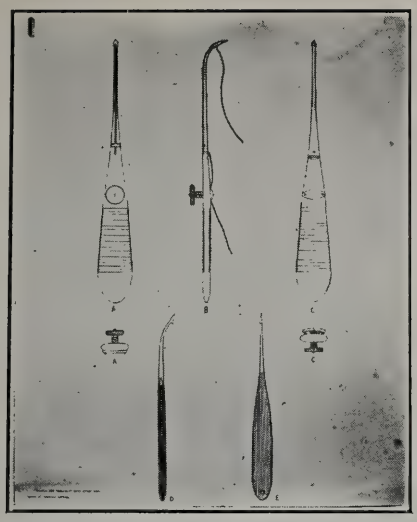

Fig. 1. Needle and "shuttle" with cross-sections of tension spring.

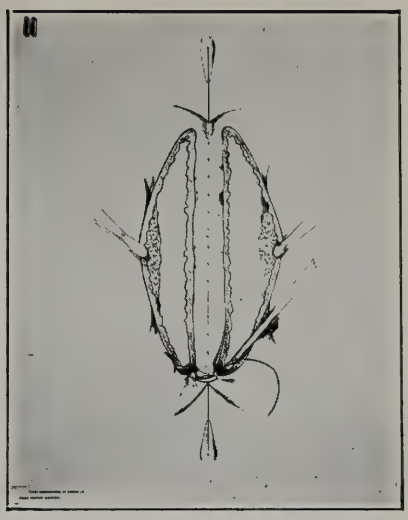

Fig. 2. First introduction of needle at angle nearest operator.

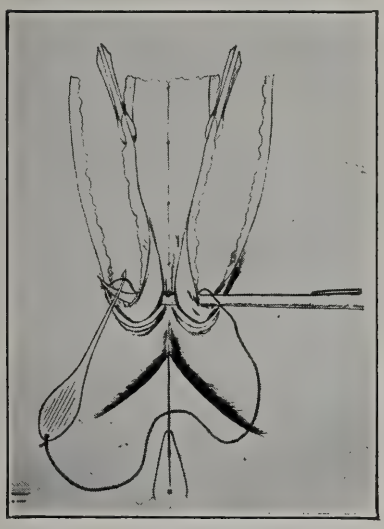

Fig. 3. The same stitch with crochet-hook "shuttle" needle ready to pass through catgut loop near eye of other needle.

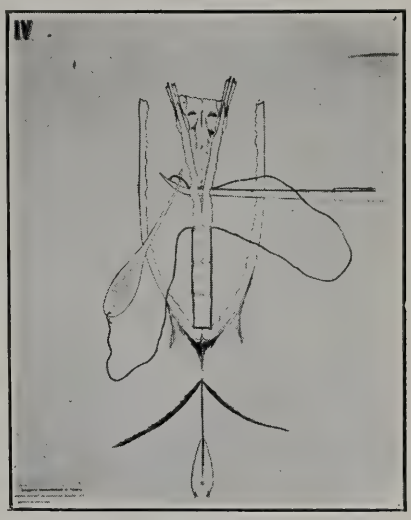

Fig. 4. Schematic demonstration of "sewing machine stitch" in posterior suture line of gastroenterostomy.

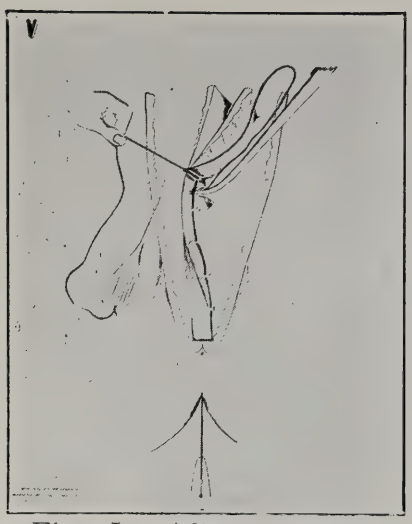

Fig. 5. After tying knot over margins of mucosae the next stitch is begun back of the knot.

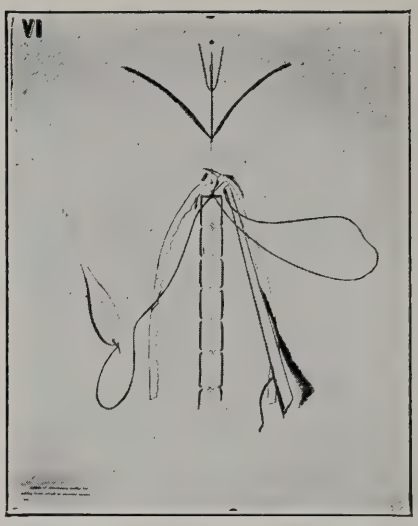

Fig. 6. Method of introducing needle for making first stitch in anterior suture line.

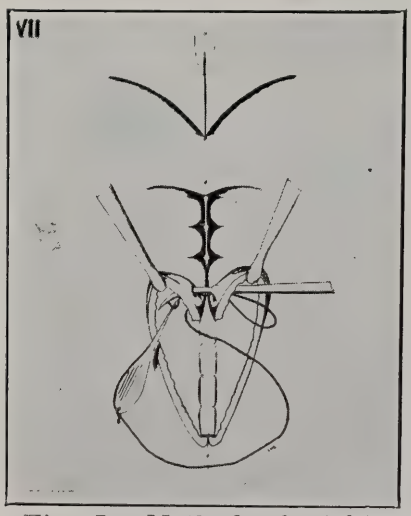

Fig. 7. Method of picking up loop of catgut in anterior suture line (note inversion of mucous membrane margins).

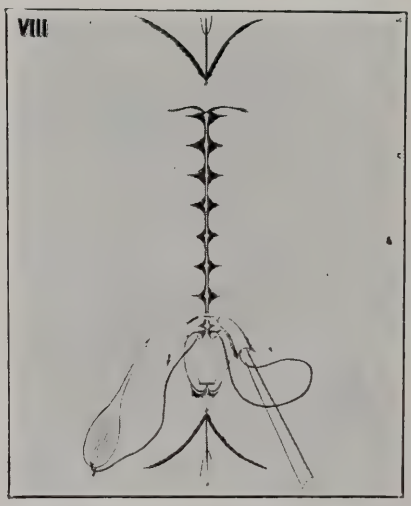

Fig. 8. Introduction of the first of the two stitches closing the final gap (note that entries and exits of needle are on the serosa).

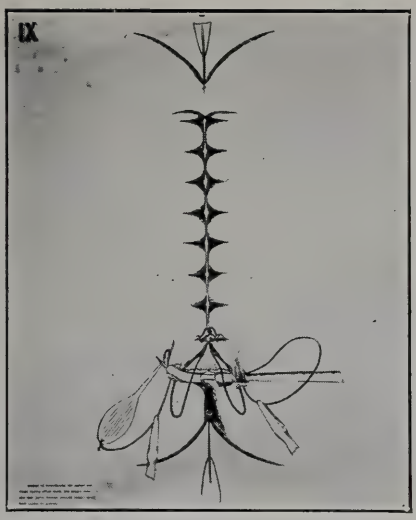

Fig. 9. Method of introducing the second and final stitch after which the catgut ends are tied (note forceps holding catgut until last stitch is placed).

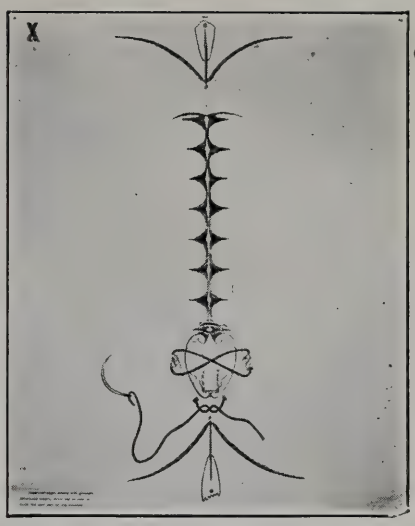

Fig. 10. Figure-of-eight suture with ordinary intestinal needle, which may be used to close the last part of the incision.

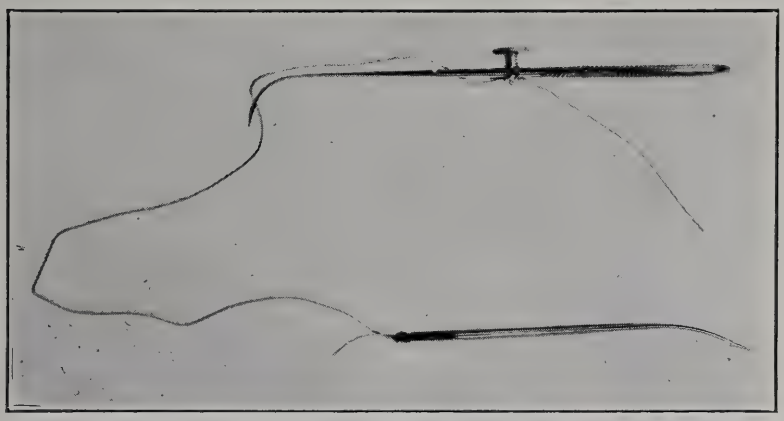

Fig. 11. Photograph showing needle properly (but loosely) threaded.

The needle point enters through the serosa of the jejunum near the center of the gap, and is passed back within the lumen to a point near the knot of the last stitch. Here the point comes out of the bowel, and is made to enter and leave the stomach at the corresponding points in exactly the reverse order. (Fig. 8.) This stitch is not pulled taut, but is grasped and held loosely by forceps on each side. The needle is again pushed into the jejunum near the point where it entered for the previous stitch, and made to come out through the serosa near the end of the incision. It enters and leaves the stomach in reverse position, and the last stitch has been placed. (Fig. 9.) The first of these two stitches is now pulled taut with the forceps already in place, and the ends are pulled up and tied. The inversion of the mucous membrane takes place more smoothly if this last stitch be inserted in the opposite direction, that is, from stomach to bowel, but as this must be done from left to right it is a little awkward and takes more time.

The last two stitches with the special needle may be supplanted by a through-and-through figure-of-eight suture with an ordinary intestinal needle. (Fig. 10.) This is advisable in any case when the gastric wall is unusually thick, or when there is an active bleeding at this unsutured part of the gastric and intestinal incisions.

The closure of a simple incision, as for instance into the stomach for exploring purposes or after the excision of an ulcer, is done in the same manner as the anterior suture line in gastro-enterostomy. In intestinal anastomosis the same plan of procedure is followed as in the gastro-enterostomy described, and needs no further comment.

If this technic has been properly followed out there will be a uniform inversion of all mucous membrane

margins, the cut tissues are all ligated, and the suture is visible at no place except, perhaps, the final knot, which is covered over by the customary musculo-serosa suture. Since the operator has both hands occupied with the two needles, it is important to have an assistant who understands the technic perfectly if the suturing is to be done accurately and rapidly. The assistant catches each of the two edges about to be sutured with a tissue-forceps, and holds them in proper position and tension for each stitch.

After a series of experiments on animals, for the perfection of the technic, the writer has now (since March 14, 1916, the date of the first operation) employed this suture method in 20 gastric and intestinal operations as follows:

11 posterior gastro-enterostomies for duodenal and pyloric ulcers.

2 excisions of gastric ulcer of the lesser curvature.

1 excision of a posterior perforated gastric ulcer through an incision in the anterior gastric wall, the latter incision being also closed by the same method.

1 anterior gastro-enterostomy for perforated duodenal ulcer.

1 anterior and 1 posterior palliative gastro-enterostomy for inoperable pyloric carcinoma.

2 end-to-side enterocolostomies after resection of the cecum.

1 side-to-side entero-enterostomy after bowel resection.

The results have been very satisfactory. That leakage is effectively prevented by this double, interlocking suture requires no argument. The time previously consumed for making a gastro-enterostomy has

been reduced by nearly one-half. To prove the hemostatic efficacy of the method in gastro-enterostomy, a gastric lavage was given to the patients with duodenal ulcer immediately after the operation, and repeated about two hours later. With the exception of a few shreds of clots in two or three instances, such as might easily have escaped during the operation performed without clamps, there was no macroscopic evidence of oozing. Occasional emesis after the operation gave the same negative evidence. Previous observations with other methods of suturing had rarely, if ever, shown such complete absence of bleeding in the post-operative vomitus.

Since this suture cuts off all blood supply from the margin of the anastomosis, it is possible that a very early sloughing and digesting away of the devitalized part may take place. It has been questioned for this reason whether this suture may not be too hemostatic for safe application to the stomach. The experiments made on dogs did not indicate that such necrosis had caused any damage. The healing of the mucosæ after two or three weeks was almost perfect. This is in line with the findings of Draper and McCarthy, who made a number of experiments on dogs to determine the fate of the devitalized tissue in the pentagonal suture for gastric ulcer. They found that, although this tissue was rapidly expelled, mucous-membrane healing took place promptly. There was no evidence of failure in healing from too early necrosis. They used non-absorbable suture material. It is the writer's belief that the catgut is digested away after any operation on the gastric mucosa long before the tissue in question has time to disintegrate. While it is admitted that this question is open for further study, a firm outer suture of the muscularis will obviate any possible danger from this source.

It is evident that the sewing-machine stitch may have other fields of usefulness in surgery, chiefly for its hemostatic effect. It has been applied with satisfaction to pedicles of omentum and broad ligament; also in hemorrhoidectomy and thyroidectomy. For the closure of skin incisions a special needle with a cutting edge was devised. But the method does not lend itself in all respects satisfactorily to skin-closure, and its use for this purpose cannot be advised.

An effort was made to learn whether this simple suture method had not previously been described in surgical literature. It was found that the principle has been mentioned a few times, not so much for hemostasis as for approximation of superficial structures. The earliest reference found was that of Michailoff (Khirurgia, Moscow, 1897, i, 285), who recommended its use in plastic operations on cervix and perineum, as well as for the closure of various skin-incisions. He applied the suture by means of a modified Reverdin's needle.

In concluding, it may be said that, after a careful consideration of the various factors involved in the employment of this suture and of the practical results obtained from its use, the writer feels justified in recommending it as a method certain to prevent leakage, rapid of execution, and efficient in hemostasis.

DISCUSSION

Dr. Clifford U. Collins (Peoria, Illinois): I would like to ask Dr. Quain the advantage of this suture over the cobbler suture, where there is a needle at each end and the two needles pass through almost the same opening as the suture progresses.

Dr. Quain (closing): In reply to the question of Dr. Collins, I will say that in my hands it is much quicker and safer than the cobbler suture. Unless you are careful you

overlook part of the tissues involved. Then you have two sharp points with which to perforate the glove.

I would like to say that there have been one or two surgeons who have used this to some extent, and they have complained that the catgut tangles up. To avoid this tangling the shuttle end of the catgut should be pulled taut through the loop before any pull is applied to the needle end.

Another thing I have found is, that, if the catgut is dipped into albolene before using, it slips much more easily through the needle. The size of the needle may be unnecessarily small, but the groove can be made larger. For general purposes it can be made a little larger, especially for thyroid work. My associate has used it in a number of thyroidectomies, and finds that it saves time, and is a more efficient hemostat than any other method he has applied to close the thyroid capsule with.

A SIMPLE AND EFFICIENT SUTURE FOR FATTY OR INFECTED ABDOMINAL WALLS

ARNOLD SCHWYZER, M.D., F.A.C.S.

ST. PAUL, MINNESOTA

The little device does not deserve the dignity of a paper, but it gave us such satisfactory results that I feel sure some of you will be glad to know of this means of safely closing the abdomen when certain conditions render it difficult.

First of all, let us assume the case is a badly infected one. We often see the peritoneum take care of the infection in the abdominal cavity; we only must allow of an exit for collections of larger quantities, especially where the peritoneum has been altered to a common abscess wall, as in the latter stages of a local purulent peritonitis. We have learned through Ochsner that, if we allow the intestines to remain quiet, a rapid agglutination occurs in the periphery of the local peritoneal infection, and through this walling-off process the infection becomes localized. The abdominal walls in these cases, however, do not dispose of the infections thus easily. While the peritonitic symptoms may promptly subside, the wound may look frightful. A tendency to sloughing in the fascia, fat, and skin can be seen, and even if the deep layers hold, extensive suppuration in the superficial layers very often becomes obnoxious and delays the recovery. The less we suture, the less is there tendency to exten-

sive sloughing. Especially the subcutaneous fat and the skin edges underneath tight sutures are prone to undergo sloughing. The interference with circulation by compression of the parts, greatly reduces the resistance of these tissues against infection. With a suppuration and retention in these superficial layers, the fascia underneath is very much more endangered, and where at times it might have resisted a certain degree of infection, it may be brought to sloughing by retention of vicious material.

The stitches of our suture emerge far enough from the wound, and are so far apart, that they do not interfere with the circulation of the skin edges. They are tied over gauze, which mitigates the pressure and hinders the sutures from cutting through. Unabsorbable buried suture material cannot be used in infected cases. Catgut is unreliable as to its lasting quality in suppurating wounds. Besides that it becomes succulent, and offers itself, not only as a safe hiding- and breeding-place for the bacteria, but it invites them to follow the stitch-channels into the tissues more distant from the cut surface. The ideal suture material would be a strongly and lastingly antiseptic thread. The silver thread comes nearest to it. The silkworm gut is so smooth that it does not give shelter to the bacteria, and it is less clumsy than silver wire. These two materials thus are most fit for a wound where serious infection obtains. The less catgut in these cases the better. Mostly one can well get along without any.

If the intestines are ballooned and if the wound has a tendency to gap, a reliable suture is necessary to retain the intestines. The suture must guarantee a firm apposition for the muscle and fascia layers; but, if we apply a simple through-and-through or a figure-of-eight suture, we exert a deleterious pressure on the skin and subcutaneous fat if we use sufficient pressure

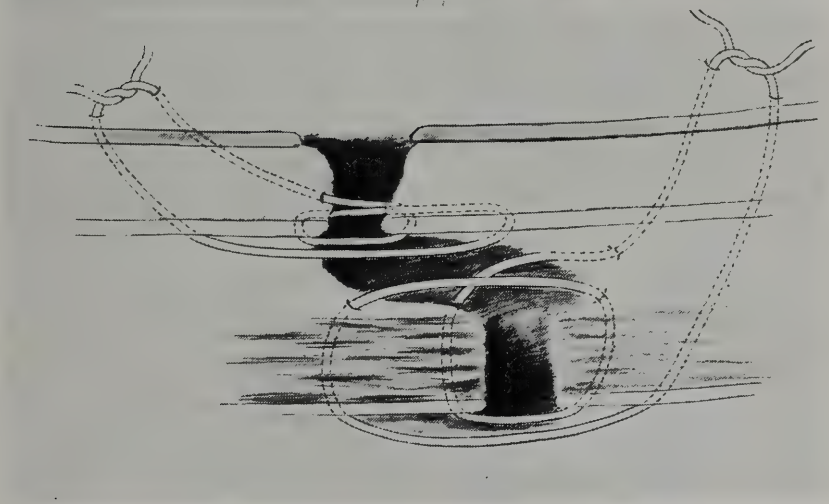

Fig. 1. (Above). The two upper threads run with one of their loops through the peritoneum for its approximation. The lower suture shows the course of the thread when the peritoneum is separately closed with a catgut.

Fig. 2. (Below.) For simplicity sake the threads are sketched as though they were running in one plane, while in reality the two loops of the same thread are not in the same plane, nor as a rule are the two superimposed threads.

to make it hold without the addition of catgut. A suture therefore which does not compress these superficial layers and which allows us even to leave them open, must have distinct advantages. If we can have the subcutaneous fat open and under no pressure at all, we also more or less reduce the danger of a severe infection of the fascia and muscle layer. This is an important point. We can even employ a moist antiseptic dressing, say with argyrol, etc., down to the fascia layer or close to it; or we can unite the skin by the finest sutures without any tension.

Another distinct advantage which I appreciated many times, is, that, after you have closed the fascia layer and tied your sutures, you can inspect the suture and improve the coaptation, if it should be necessary. You can feel for a weak spot, and add a suture if needed. And in the end, an incision, for instance, with a depth of three inches and a length of eight inches, is safely closed with no other foreign material in the wound than half a dozen silkworm sutures, each of which forms a double loop. We are used to call it the "lateral double-loop stitch." The sketch (Fig. 1) explains it very readily, and you can see that, if the sutures emerge not too near the wound, the skin edge is somewhat drawn toward the wound. In fact you have it in your hand to use this approximating force as much as or as little as you like. Often we see the skin edges so well approximated that it needs only a few stitches to keep the skin in correct apposition. Where we want to make use of this approximation of the skin we can alternately insert the sutures from both sides. Where we suture the muscle and fascia area in two layers, we insert the deep sutures from one side and the more superficial ones from the other. This gives us an overlapping and strengthens the wound. (Fig. 2.)

In some patients the tissues, which have once been seriously infected, are very prone to suppuration at a later attempt at closing of an abdominal hernia. One has to be careful not to handle these tissues more than is absolutely necessary. They should be cut, not torn. Catgut should be avoided, if possible; and the less suture material there is in the wound, the better.

I am often asked if these sutures are easily removed. They are mostly not unless you use a little trick; and that is, you cut the sutures one day, and the next day you pull them out. They then work themselves loose, and come out without trouble if one avoids making a noose when putting them in.

To sum up the advantages of our lateral double-loop stitch:

1. It is a tight, reliable suture with a removable thread.
2. It approximates the deep layers more firmly than the figure-of-eight or the ordinary through-and-through suture.
3. You can inspect the fascia suture after it is tied.
4. The edges of the skin and fat are left free from pressure.
5. You can drain the whole fat area if desirable, or leave it open.
6. The suture does not easily cut through. It is, therefore, especially useful in infected and in fatty abdominal walls.

DISCUSSION

Dr. Warren A. Dennis (St. Paul): This suture of Dr. Schwyzer's, I think, will appeal to everybody because the infected abdominal wound is very difficult to hold and because catgut gives way easily. It seems to me, it might be valuable in the upper abdomen, which is the *bête noir* of myself and, I think, of a good many others. There is so much tension

in the upper abdomen, and the peritoneum is so adherent to the fascia beneath, it is impossible in many cases to suture the peritoneum separately.

Dr. Schwyzer has spoken of separate peritoneal sutures, which are indicated for the lower abdomen, but not the upper. Our experience has been that in the infected cases it is a question whether anything will hold, because, as soon as the tissues are somewhat infiltrated, if there is much tension, any suture is likely to cut out,—silk-worm gut as well as any other. In clean cases it is an excellent suture, but in the infected cases I do not think it would be so good. Formerly, when we attempted to close the upper abdomen in layer sutures we found difficulty in closing the peritoneum; with so much tension, the sutures would tear out, and every once in a while a ventral hernia resulted. In the last two years, however, we have used a suture that has given us practically complete immunity from hernia, that is, double catgut, which enters through the fascia on one side and includes the muscle and peritoneum, then out in the same manner on the other side, so that all the deeper tissues of the two sides are included in the suture. Then the catgut is carried across to the other side and made to include the fascia only of the rectus, and then the fascia of the rectus on the other side. This gives a figure-of-eight stitch, which includes the wall except fat and skin. This suture has enough material in its bite so that it never tears out, and each one tied makes the next one easier to place. The disadvantage which Dr. Schwyzer suggests in making pressure upon fat and skin is avoided, for a separate suture is put in to close the fat and the skin. This suture seems to hold very well in a good many cases, even though they are infected. However, this looks to me like an admirable suture, and one well worth trying.

Dr. Henry T. Byford (Chicago): I would like to ask if in cases of very fat abdomens the compressibility of the fat would not allow a little relaxation of the suture at the end of the second or third day, or possibly at the end of a few hours in case there was intestinal stasis or the accumulation of gas to produce tension upon it and tension from the suture as it presses against the thick fat layer.

Dr. M. L. Harris (Chicago): I would like to illustrate a little scheme which I have employed for this same purpose. You have all had difficulty in suturing these septic wounds. Placing the gauze under the suture where it is tied, it is out-

side, and it cuts at this point (indicating), and relaxes. To overcome that, we have a deep wound to be held together, and I have used wire because infection never travels along a wire suture. It prevents the wire suture from cutting and having tension on the edge. Here to the abdominal wall (illustrating), I pass this wire suture, starting in some distance from the wound, going in deeply and along the layer where it cannot come out. The suture passes over, and goes through a little here and comes right back over it so it draws against this point (indicating), and then I twist it here through this. Those sutures will draw the wound together, there is no cutting of the point where the suture comes out. It does not cut out into the tissues, and to take up the fat which Dr. Byford called attention to, these flaps are drawn up and placed farther out at the time so that the tension is all taken up. I find it holds more tension than any suture I have been able to devise.

Dr. Schwyzer (closing): This little device has been so satisfactory in over 300 cases that I thought it would be worth while to bring it before the Association. In fatty, infected cases often we have difficulty with the wound edges. You can see Dr. Harris has tried to avoid that compression.

In answer to the question of Dr. Byford, as to the getting loose of the sutures, I would say that, if we have a double loop, if you pull on the sutures before you tie them and let them go afterwards, they hold. We have not had difficulty in regard to their getting loose later on. Furthermore, Dr. Harris mentioned that the suture may cut through towards the skin edge. It has not done so in a single case that I remember because the fat turns up a little bit and the pulling is straight inward. Dr. Dennis has used a similar suture with catgut. In clean cases his is a good suture, and holds the important parts firmly together.

PERFORATIONS OF GASTRIC AND DUODENAL ULCERS

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That ulcers of the stomach and duodenum frequently destroy all the coats does not seem strange when one considers the thin walls of these viscera. According to the best statistics obtainable 20 per cent of the duodenal ulcers sooner or later perforate, while perforation occurs in only about 7 per cent of the gastric ulcers. Why perforation should be three times as likely to occur in duodenal as in gastric ulcer is not clear. It does not seem reasonable that it is entirely due to the thinner wall. The apparently greater tendency for infiltration and thickening of the base of a gastric ulcer may give it greater immunity.

It is desired to limit this paper to a consideration of so-called acute perforations. These are almost all fatal unless an early diagnosis is made, and proper treatment carried out before the resulting peritonitis is too far advanced. It is fortunate that most of these perforations are in the anterior wall of the stomach and in the more accessible portions of the duodenum.

In so acute and serious a condition, where prompt operation is all-important, it is bad practice to load up with a multiplicity of diagnostic signs which are time-consuming, burdensome to a suffering patient, and not of very much consequence anyway. Among

the diagnostic points, then, only those of capital importance, and those that can easily be made use of at the bedside, without waste of time, will be considered.

The onset is always sudden, the course rapid, and, unless a timely operation is done, there is inevitably a fatal ending. Uppermost in one's mind should be kept the fact that this calamity must be met promptly, with the best proven methods, and that each hour's delay will be penalized by the loss of a definite per cent to the operative chances.

After learning of the sudden onset of pain, if carefully questioned, the patient will usually give a history of previous gastric symptoms, and will often describe a feeling of increased discomfort and vague stitch-like pains in the upper abdomen lasting several hours or even days before the storm bursts. These symptoms are probably due to the fact that the ulcer had penetrated to the peritoneal coat and produced a localized irritation or inflammation of the peritoneum at the site of the impending perforation. At this stage, when the benevolent omentum drops over the irritated spot and adheres, a so-called chronic perforation occurs and acute perforation is prevented. Or if, instead of the omentum, a wide-awake surgeon should happen along, learn of the increase in intensity of the symptoms, and rightly interpret them, and advise an immediate operation and have the advice accepted, he could forestall the perforation. Although such a contingency is not to be looked for every day, it is conceivable and would avert a serious calamity.

The first symptom of perforation is sudden, acute, agonizing, unendurable pain. The patient lies absolutely still because every movement increases his suffering. Every one I have questioned on this point has said that he had never before conceived that such extreme torture could be. He scarcely dares breathe,

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for even ordinary respiration increases the pain. The tense, motionless attitude is in marked contrast to the extreme restlessness of one suffering from severe colic, whether it be renal, intestinal, or hepatic; for these conditions are marked by continual changes of position with the hope of getting relief. The torture from a perforating gastric or duodenal ulcer seems several degrees greater than that from a perforation of the gall-bladder or the appendix. This is probably accounted for by the acid gastric juice coming in contact with the peritoneum.

Almost immediately after the perforation the abdominal muscles become intensely rigid. The board-like rigidity is so great that one might stand on the abdomen and make no impression on the tensely contracted muscles. During the first few hours the rigidity, if it be possible, is even greater over the site of the perforation than over the other regions of the abdomen, though this is comparing one superlative with another superlative. In the beginning pressure over the seat of the lesion elicits more exquisiteness of tenderness than in other places. The early pain of perforating gastric ulcer is much the same as that from perforation of the duodenum. After an hour or two there are one or two points of distinct difference. The pain and tenderness following the perforation of an anterior gastric ulcer are more general, especially in the central and left abdomen, due to the more general soiling of the peritoneum by the pouring out of the gastric contents. On the contrary the fluid passing through a perforation of the duodenum is carried along the trough of the transverse colon towards the right, around the hepatic flexure, and down along the outer side of the ascending colon to the right iliac fossa. And thus it is often found in an hour or two after perforation of a duodenal ulcer the greatest point of

tenderness appears to be in the region of the appendix. For this reason a pre-operative diagnosis of ruptured appendix is common. In two of my own cases this error was made. It is an awkward mistake, and necessitates an additional incision or an unnecessarily long incision when the appendiceal wound is extended upwards. Greater care in eliciting the anamnesis, and a patient effort to learn the exact location of the primary pain, will often make it possible to avoid such an error. It is rare that perforation of the appendix occurs without some preliminary symptoms in the right iliac fossa.

After perforation of a gastric or duodenal ulcer only a few hours will elapse before the symptoms become those of general peritonitis. Most of my cases had reached this stage before I had an opportunity to examine them. After the onset of peritonitis the pain and tenderness are so general and the tenderness at the seat of perforation so nearly the same as that all over the abdomen that little knowledge of the primary lesion can be gained by examination at this time. If a correct diagnosis is made when the patient is not seen until the advent of general peritonitis, it must depend on the location of the first pain, its intensity, and the history of the case before the perforation occurred. If ideal conditions obtain, the diagnosis will be made, and operation done, before the onset of general peritonitis. At this time the diagnosis is easier and more likely to be accurate, and the chances of successful operation are much better. Every hour that elapses after the perforation increases the mortality rate. Unfortunately, many of these cases are not operated on until the peritonitis is well advanced. It would be better to be operated on by a sensible surgeon of only limited experience within six hours after a perforation than by the best surgeon in the United States twenty-four hours later.

Whether it is possible to make a definite pre-operative diagnosis or not, it is always apparent that a serious intra-abdominal calamity has occurred, and the indications cry out loudly for an immediate operation. When this call is not heeded the attendant takes upon himself a burden of responsibility too heavy for any man to carry.

Careful but rapid preparations should be made, preferably in a hospital, but in the patient's home if the hospital is too far away. The incision is made high up to the right of the median line, or in the median line if the greatest tenderness is there. Gastric or duodenal leakage usually leads one at once to the seat of the perforation, where gas and duodenal or gastric contents can be seen to be seeping out.

The point on which there is the greatest disagreement is how much or how little shall be done. Shall the perforation be sutured in the simplest manner possible, and the operation end there? Shall the perforation and ulcer be so thoroughly turned in with superimposed sutures that it produces narrowing of the outlet of the stomach? Shall the ulcer be excised? Shall an omental graft be used? Shall gastro-enterostomy be done? Shall drainage be used in every case and, if so, how?

Hard-and fast-rules will never apply in lesions of this kind. For the best results the type of operation will have to conform to the pathological conditions found. Where the operation is done early before peritonitis has developed, the procedure will never be the same as in the cases of advanced peritonitis. When the operation is early it can at least approximately conform to the method followed in an ordinary ulcer with stenosis, such as the surgeon is so frequently called upon to perform. In such a case the thorough turning in of the ulcer with sutures to the degree, as nearly as possible, of obliterating the outlet of the stomach,

is a reasonable procedure. To make assurance doubly sure, I like to overlap the gastro-hepatic omentum and the right border of the great omentum over the line of suture, and hold them there with one or two stitches. If the perforation is very recent, and the ulcer can be excised without too much additional risk, and the wound closed and covered as before, it is still better. The last-named procedure commends itself, not only from a natural desire to get rid of the pathological conditions and render improbable another perforation, but to minimize the chance of cancer developing in the border of an imperfectly healed ulcer. In either event the next logical step is to perform a posterior gastro-enterostomy, the opening in the stomach being made as near the pylorus as practicable.

If the perforation is on the anterior wall of the stomach away from the pylorus, excision of the ulcer or turning it in is all that is necessary. Gastro-enterostomy in such a case will serve no useful purpose. If the perforation is in the posterior wall of the stomach, it can usually be sutured from behind, either by working through a slit in the transverse mesocolon or sometimes through a slit in the lesser omentum.

Should the operation be done very early, and the leakage found to have been very slight, I can conceive that it might be proper to close the abdominal wound without drainage. Personally, I have never done this, because I was afraid. In the few cases operated on early there has always been enough leakage to make me fear the consequences of complete closure of the abdomen. In some cases the original wound has been closed, and only drainage of the cul-de-sac made use of, keeping the patient in the Fowler position.

Even in cases with a very young peritonitis the method already described can safely be employed. The more advanced the peritonitis, the more is a gastro-

enterostomy to be feared. Inflamed and infected peritoneum is very prone not to heal kindly. The more advanced the peritonitis, the less likely is it to heal promptly and perfectly. Furthermore, when the peritonitis is far advanced and the vitality of the patient reduced, his ability to withstand the more prolonged operation is greatly lessened.

It is my conviction that in late operations the less we do besides stopping the leak and establishing adequate drainage the better. Simple suture of the perforation in a direction to produce the least possible narrowing of the stomach outlet and covering the site of the perforation with an omental graft is quickly done. Even though a gastro-enterostomy has to be performed later it can be done much more safely after the peritonitis is relieved. I am very much in favor of doing the operation in two stages rather than subjecting the patient to unnecessary danger by doing the more complete operation when he is in very poor condition to stand it. Many of these cases will not require a subsequent gastro-enterostomy, if undue narrowing of the stomach outlet is avoided.

The manner of draining is of the utmost importance. Poorly placed and badly chosen drains have cost many lives. If the operation is done fairly early, drainage at the site of the perforation is not always necessary. A large rubber tube, not too hard, but not too easily collapsible, introduced through a stab-wound above the pubes and accurately placed at the bottom of Douglas' cul-de-sac by a guiding hand in the abdomen, and kept syphoned out, is sometimes all the drainage required.

In the majority of cases greater safety seems to lie in additional drainage in the region of the perforation. A split rubber tube containing a roll of gauze or a cigarette drain, the size of the tube or cigarette

drain depending on the extent of the pathological condition, seems to be much better than more massive drainage. Unless the perforation is exceedingly minute and the leakage practically nil, I should not be satisfied without the tube in the cul-de-sac, whether the primary wound is drained or not.

There seems to be more or less difference of opinion with reference to the best disposition to be made of the migrated gastric contents and the inflammatory products resulting from the peritonitis. I can only give my own method and the reasons for it. I never irrigate the peritoneal cavity under any circumstances. If the operation is early, before peritonitis has begun or before it has become general, irrigation is bound to carry gastric contents or infective material to portions of the peritoneal cavity not yet involved. It converts a local trouble into a general one.

When peritonitis starts, nature immediately begins its benign work by throwing out an exudate on the peritoneal surface of fibrin and leucocytes which with the serum form a film of protection, which prevents rapid absorption of the toxins and microörganisms and safeguards the body against an overwhelming toxemia or infection. Irrigation, no matter how gently done, washes away this protecting film, opening the avenues of absorption. I have seen such acute toxemia follow irrigation that a fatal issue resulted in a few hours.

I make no great effort to get rid of the peritoneal debris. Wiping it away is almost as bad as irrigation. If gross particles show themselves they may be gently picked away or dipped out with a large spoon or soup-ladle. Sometimes a pool of foul material may be stopped up with a large gauze sponge wet in normal salt solution. The gauze should never rub or wipe.

After the operation, with drainage of the cul-de-sac, the Fowler position and the Murphy method of using

salt solution per rectum, there will be sufficient current of serum in the direction of the cul-de-sac to pretty thoroughly clear away the debris within a few hours. The peritoneum is able to so far disintegrate any gross particles that they are easily carried along by the current. It is so gently done that no violence is done the peritoneum, as would have happened by irrigation or sponging in too great eagerness to secure an ideal peritoneal toilet.

FOR DISCUSSION SEE PAGE 73

RESULTS OF SURGICAL TREATMENT OF GASTRIC ULCER

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The surgical treatment of gastric ulcer should not be undertaken with a preconceived idea of the type of operation to be performed. Any routine method of dealing with benign lesions of the stomach is neither intelligent surgery nor a contribution toward further progress in the treatment of diseases of the stomach. Although evidence is conclusive that surgery gives permanent relief in a higher percentage of cases and with less associated risk than any other therapeutic measure, it is also true that the surgical treatment of gastric ulcer may be made still more efficient. Although I am quite aware that other factors than operative technique should be considered, the main purpose of the present paper is to present the result of an investigation to determine the relative merits of the various operative precedures employed in the treatment of gastric ulcer.

The conclusions are based on six hundred and seventy-seven gastric ulcers operatively demonstrated in the Mayo Clinic during the past ten years. No consideration has been taken of ulcers of doubtful situation. Even "pyloric lesions" in which the ulcer has not been positively located on the gastric side of the pylorus, have been excluded, as have been also acutely

perforated ulcers and those which after removal exhibited evidence of early malignant change.

The impression that the results of operation vary to a large degree with the situation of the ulcer having been confirmed, it was necessary, in order to obtain a fair estimate of results, to classify gastric ulcers into the following groups:

1. Ulcers near the pyloric outlet.
2. Ulcers on the lesser curvature.
3. Ulcers on the posterior wall.
4. Ulcers on the anterior wall.
5. Ulcers producing hour-glass contraction.

Certain principles hold true in the treatment of all gastric ulcers. While the frequency with which gastric carcinoma is preceded by ulcer may be a basis for argument, it must again be emphasized that gastric ulcers do at times become carcinomas. The premise, therefore, that gastric ulcer should, if possible, be excised or destroyed may be accepted as logical. The routine adherence to such a principle, however, is difficult from a technical standpoint; and the absence of positive signs of malignant change may persuade the surgeon, against his better judgment, to base his treatment on the assumption that there is no malignancy. Although fully recognizing the importance of the removal of the ulcer-bearing area because it is a potentially malignant lesion, we must also bear in mind the fact that malignancy with comparative rarity develops in a gastric ulcer for which gastro-enterostomy alone has been done.

Unfortunately, there is no certain method of consistently determining early malignant invasion of an ulcer. In some instances valuable suggestive evidence is found in the history of the patient, the *x*-ray findings, and the chemical characteristics of the gastric juice, while in others positive proof is obtained by gland ex-

amination. The transitional stage between ulcer and cancer cannot be detected at the operating-table; and a segment of the ulcer excised for examination may not demonstrate malignant change, although cancer cells may be present in other portions of the base.

The extent of the induration and the degree of its activity must be taken into careful consideration in arriving at a decision as to the operation of choice. An inflammatory mass of large size with gross evidences of subacute perforation, as a rule, precludes excision or resection, while perigastric extension sufficient to involve other organs, such as the liver or the pancreas, should usually be a warning against attempted removal.

1. *Ulcers near the Pyloric Outlet.*—In this group there were 197 ulcers, 29 per cent of the total. It seems to be indisputable that ulcers close to the pylorus are more readily amenable to successful surgical treatment than those in any other portion of the stomach. (Brewer,[1] Woolsey,[2] and others.) Particularly when mechanical obstruction has occurred from contraction of the ulcer or by reason of its actual size, operation is followed by eminently satisfactory results. The technical difficulties incident to the removal of such ulcers are less than those encountered with other gastric ulcers, but their surgical treatment demands more mature judgment as to the correct operative procedure to follow. It is difficult, for example, to determine whether early malignant change has occurred in such ulcers; and, inasmuch as usually the pyloric end of the stomach, including the ulcer area, can be resected without prohibitive added risk, considerable responsibility is assumed in deciding that a suspicious lesion at the outlet is not malignant. Conversely, the decision that a lesion is malignant may mean an unnecessary resection. When long-continued obstruction

has produced a degree of emaciation which permits of only a gastro-enterostomy, the error of assuming the growth to be malignant may result in an unnecessary pylorectomy later. It is in this type of case also that, occasionally, a hopeless prognosis is given to the patient, and in which a palliative gastro-enterostomy for the supposed extensive carcinoma is followed, not only by relief of symptoms, but by a return to permanent good health.

The relative frequency of operations from January 1, 1906, to November 1, 1916, for gastric ulcers near or involving the pylorus was as follows:

Table I

Posterior gastro-enterostomy.....	105	(53 per cent)
Pylorectomy (Rodman, Billroth, No. 1, Polya, and others).....	41	20 " "
Excision and pyloroplasty	12	6 " "
Cautery and gastro-enterostomy...	11	5.5 " "
Anterior gastro-enterostomy	10	5 " "
Pyloroplasty	8	4 " "
Excision and gastro-enterostomy...	7	3.5 " "
Excision	1	0.5 " "
Reinforcement	1	0.5 " "
Closure	1	0.5 " "
Total	197	

2. *Ulcers on the Lesser Curvature.*—These comprise 316 of the gastric ulcers, or 46.6 per cent of the total, being thus considerably the most common type, especially in view of the fact that many of the ulcers classified in the preceding group,—that is, ulcers in the pyloric outlet,—developed on the lesser curvature. Their tendency to localize on the lesser curvature and to spread onto both anterior and posterior walls of

the stomach, accounts for the term "saddle ulcer"; however, it has been our experience that such ulcers tend to extend to the posterior wall rather than to the anterior wall. These ulcers frequently illustrate in a marked degree the discrepancy in size between the area of induration and the actual crater of the ulcer. It was in these lesser curvature lesions that the cautery was first employed as a surgical measure. A sufficient number of patients have now been operated on by this method to prove its safety and efficiency, and our own observations have been confirmed by others, particularly Scudder and Harvey.[3]

Lesions are repeatedly found in which excision would be inadvisable and of decided risk on account of the wide area of induration and of the inaccessibility of the ulcer due to its high situation on the lesser curvature, but in which complete destruction of the crater of the ulcer can be accomplished with the cautery. For lesser curvature ulcers the following operations were performed:

Table II

Posterior gastro-enterostomy	93	(26.6 per cent)
Excision	72	20.6 " "
Cautery and gastro-enterostomy (two years)	62	17.7 " "
Excision and gastro-enterostomy	37	10.6 " "
Pylorectomy	20	5.7 " "
Gastrogastrostomy	14	4.0 " "
Anterior gastro-enterostomy	11	3.0 " "
Sleeve resection	10	2.8 " "
Pyloroplasty	8	2.0 " "
Cautery and pyloroplasty	7	2.0 " "
Excision and pyloroplasty	7	2.0 " "
Jejunostomy	3	0.8 " "
Exploration	2	0.5 " "

Suture compression	2	0.5 " "
Reinforcement	1	0.2 " "
Total	349	

3. *Ulcers on the Posterior Wall.*—There were 63 ulcers on the posterior wall, constituting 9.8 per cent of the series. These have an added surgical interest, since, with the problem of the local treatment of ulcers, various routes to gain access to the ulcer may be chosen by the surgeon,—for example, through the gastrohepatic omentum, through the mesocolon, by separation of the omentum from the transverse colon (Pauchet[4]), or through the anterior wall of the stomach. If the crater of the ulcer is not of large size, and there is little evidence of peritoneal irritation about the ulcer area, its excision may be attempted. Even if the ulcer has perforated into the pancreas, it may be still possible and safe to separate the stomach from its resulting attachment, and trim out or sterilize the edges of the ulcer and close the defect. The following operations were used in this group:

Table III

Posterior gastro-enterostomy	17	(21.0 per cent)
Pylorectomy	10	12.5 " "
Excision and gastro-enterostomy	8	10.0 " "
Gastrogastrostomy	8	10.0 " "
Pyloroplasty	6	7.5 " "
Cautery and gastro-enterostomy	6	7.5 " "
Anterior gastro-enterostomy	5	6.0 " "
Excision	5	6.0 " "
Jejunostomy	4	5.0 " "
Cautery and pyloroplasty	4	5.0 " "
Excision and ploroplasty	2	2.5 " "
Sleeve resection	2	2.5 " "

Reinforcement	2	2.5	" "
Closure	1	1.2	" "
Total	80		

4. *Ulcers on the Anterior Wall.*—Ulcers on the anterior wall constitute a relatively small group, there being but 17 in the series, or 2.5 per cent of the total. Such ulcers are easily excised by knife or cautery unless perforation has occurred with attachment to the anterior abdominal wall. The following operations were made in this group:

Table IV.

Excision	6	(25.0 per cent)
Pylorectomy	5	20.8 " "
Cautery and gastro-enterostomy	5	20.8 " "
Pyloroplasty	3	12.5 " "
Posterior gastro-enterostomy	2	8.3 " "
Excision and pyloroplasty	2	8.3 " "
Jejunostomy	1	4.0 " "
Total	24	

5. *Ulcers Producing Hour-glass Contraction.*—In the group of ulcers producing hour-glass contraction are 58 cases, or 8.5 per cent of the total number. The characteristic deformity warrants a separate classification, although the contraction may be produced by an ulcer of the anterior or posterior wall or an ulcer of the lesser curvature. These are most interesting from a surgical standpoint, for they tax the resourcefulness and skill of the surgeon and stimulate his ingenuity.

A wide variety of operative procedures are at the choice of the surgeon, the selection being governed by the condition of the patient, the pathologic findings, and the capability of the surgeon. The ulcer which

has produced the deformity may be so situated that resection of a complete segment including the ulcer and the scar may be possible. This operation, which entails an end-to-end union of the resected stomach, has given excellent results in our hands, and has been reported upon favorably also by others. (Haines.[5]) It has been recently shown by Stewart and Barber[6] that after "sleeve resection" the motility of the stomach more nearly approximates the normal than it does after resection of a V-shaped segment from the lesser curvature. However, this or, in fact, any type of resection is not always possible, for the ulcer may have become so firmly fixed that the stomach cannot be mobilized, under which circumstances drainage must be procured either by gastrogastrostomy or by gastro-enterostomy on the proximal or distal segment of the stomach. Should the ulcer be situated on the anterior wall, and should the greater part of the scar be accessible, satisfactory results may be obtained from excision of the ulcer, or from puncture with the cautery point and correction of the original deformity by a gastroplasty.

The operations which have been done in the Clinic for hour-glass contractions are the following:

Table V

Gastrogastrostomy	22	(39.0 per cent)
Posterior gastro-enterostomy	8	13.8 " "
Pyloroplasty	8	13.8 " "
Sleeve resection	4	6.7 " "
Cautery and gastro-enterostomy	4	6.7 " "
Pylorectomy	4	6.7 " "
Anterior gastro-enterostomy	2	3.4 " "
Jejunostomy	2	3.4 " "
Excision	2	3.4 " "
Excision and pyloroplasty	2	3.4 " "
Total	58	

In the compilation of these statistics, the mortality records detail important information as to the relative risk of the various types of operation, as well as the risk according to the situation of the ulcer.

In Tables VI and VII, although there are several figures to which I might allude, I would draw attention to the fact that in 87 operations by the cautery method combined with gastro-enterostomy there was one death. Moreover, in the case of this patient a double operation was done, the primary operation being

Table VI

A Series of 670 Gastric Ulcers According to the Type of Operation

(January 1, 1906, to November 1, 1916)

	Operations	Mortality	
Posterior gastro-enterostomy	228	4	(1.7 per cent)
Cautery and gastro-enterostomy	87	1	1.1 " "
Excision	84	4	4.7 " "
Pylorectomy	77	6	7.7 " "
Excision and gastro-enterostomy	52	2	3.8 " "
Anterior gastro-enterostomy	27	1	3.7 " "
*Pyloroplasty	26	2	7.0 " "
*Excision or cautery and pyloroplasty	35	3	8.5 " "
Gastrogastrostomy	23	1	4.3 " "
Sleeve resection	12	0	0.0 " "
Miscellaneous	10	0	0.0 " "
Jejunostomy	8	1	12.5 " "
Total number reported in this series	670	24	3.5 " "

*This mortality is not representative of pyloroplasty by the Finney method, which in our experience in ordinary cases has given a mortality of less than 3 per cent. The group of cases in which the operation was performed included a number of poor surgical risks, with extensive local disease, so that the operation was often one of expediency rather than one of choice.

cholecystectomy for a septic gall-bladder in the subacute stage. The necropsy report stated that the stomach was in perfect condition, and that the cause of death was septic cholangitis.

Table VII

A Series of 670 Gastric Ulcers According to Position

(January 1, 1906, to November 1, 1916)

	Cases		Mortality	
Ulcers of the lesser curvature	349	(52 per cent)	12	(3.4 per cent)
Ulcers close to or involving the pylorus	197	29 " "	3	1.5 " "
Ulcers on posterior wall	80	12 " "	6	7.5 " "
Ulcers on anterior wall	24	3.5 " "	1	4.0 " "

In considering the results of the various operations employed in the treatment of gastric ulcer, it would be advisable to state the basis on which these results were compiled. The information was obtained through a form-letter sent to each of the patients operated on in the Mayo Clinic for gastric ulcer from January 1, 1906, to July 1, 1915. The letter was so constructed that we believe we have obtained an accurate estimate of the results of the operations, for, inasmuch as they were performed primarily for the relief of subjective symptoms, the patients become the final arbiters as to the success of the treatment. It has further been our experience that those failing to reply to inquiries of this kind are likely to be enjoying good health. It should be noted that at least a year and a half has elapsed since the last case considered in this report. Criticism may be offered that the present health of the

patients operated on as recently as eighteen months ago is not a criterion of the late results, but experience has shown that a recurrence of symptoms rarely occurs after the patient has had relief for a year. It is also a fact that in the event of such recurrence it is due probably to the development of a new ulcer rather than to a failure to cure the original ulcer.

The results of operation in all cases of gastric ulcer are tabulated in Table VIII.

Table VIII

Results of Operations for Gastric Ulcers

(From January 1, 1906, to July 1, 1915)

Total number of patients heard from	285	
Cured	159	(55.7 per cent)
Greatly improved	65	22.8 " "
Slightly improved	28	9.8 " "
No better	33	11.5 " "
Satisfactory results	224	78.9 " "

The percentages are based on information from 285 patients who were operated on previous to July 1, 1915. Deaths which occurred months or years after operation are excluded in this report, but are being carefully investigated and will undoubtedly contribute much desired information as to the life expectancy and the possibility of the development of cancer, as well as other fatal late complications, in those operated on for gastric ulcer.

Table IX

Recapitulation: Operations

Operations	Number	Satisfactory Results	Operative Mortality	Secondary Operations
Posterior gastro-enterostomy	228	84 per cent	1.7 per cent	1.8 per cent
Pylorectomy	77	90 " "	7.1 " "	3.9 " "

Operations	Number	Satisfactory Results	Operative Mortality	Secondary Operations
Excision and posterior gastro-enterostomy	52	83 " "	3.8 " "	3.9 " "
Cautery and posterior gastro-enterostomy	87	*	1.1 " "	0.0 " "
Excision	84	57 " "	4.7 " "	32.0 " "
Sleeve resection...	12	90 " "		
Anterior gastro-enterostomy	27	72 " "	3.7 " "	3.8 " "
Pyloroplasty	26	75 " "	7.0 " "	15.0 " "

*So little time has elapsed since this operation was instituted that a statement as regards the present condition of the patients would be of no real value.

Table IX is a recapitulation of the results of the various operations for gastric ulcer, with the operative mortality and the percentage of the patients so operated on who returned for secondary operations.

Table X is an abstracted compilation of these secondary operations.

Table X

REPORT ON SECONDARY OPERATIONS ON GASTRIC ULCERS (47 CASES, OR 6.8 PER CENT OF 670)
(From January 1, 1906, to November 1, 1916)

Original Operation	Time Since First Operation	Cause for Second Operation	Second Operation
Excision, 27 cases	1–1.5 yrs., 7 cases 2–2.5 yrs., 5 cases 3–3.5 yrs., 5 cases 4 yrs., 1 case 4–10 mos., 4 cases 1–2 wks., 3 cases 10–18 days, 2 cases	Obstruction, 10; ulcer bleeding, 3; ulcer, 3; hour-glass, 3; distention, 2; adhesions, 1; subacute perforation, 1.	Posterior gastro-enterostomy, 25; anterior gastro-enterostomy, 1. Adhesions were freed in 2 of the above cases. An old scar excised and a transfusion in another.
Excision and posterior gastro-enterostomy, 2 cases	2 mos., 1 case 6 days, 1 case	Obstructions from kinked pylorus, 1; obstruction and abscess, 1.	Anterior gastro-enterostomy, 1; drainage of abscess, jejunostomy and transfusion, 1.
Excision and pyloroplasty, 4 cases	2 yrs., 2 cases 1 yr., 1 case. 1 mo., 1 case.	Ulcer, 2; Abscess, 1.	Cautery and posterior gastro-enterostomy, 1; excision and gastro-enterostomy, 1; posterior gastro-enterostomy, 1; drainage of abscess, 1.
Pylorectomy, 3 cases	6 yrs., 1 case. 3 yrs., 1 case. 5 days, 1 case.	Jejunal ulcer, 1; carcinoma of stomach, 1; acute obstruction and dilatation, 1.	Anterior gastro-enterostomy (Murphy button), 1; transverse colon resection and resection of jejunum and jejunostomy 10 days later, 1; exploration, 1.
Anterior gastro-enterostomy, 1 case	1 week, 1 case.	Bile regurgitation, 1.	Entero-anastomosis (Murphy button), 1.
Posterior gastro-enterostomy, 4 cases	3 yrs., 1 case. 1 yr., 1 case. 2 weeks, 1 case. 10 days, 1 case.	Ulcer, 3; ulcer causing hour-glass, 1.	Freeing adhesions, 1; enlargement of gastro-enterostomy, 1; excision of ulcer, 1; resection of pylorus, 1.
Gastrogastrostomy, 4 cases	3 yrs., 1 case. 2 yrs., 1 case. 1 yr., 1 case. 1 mo., 1 case.	Hour-glass, 1; adhesions, 1; bleeding ulcer and adhesions, 1; obstruction, 1.	Posterior gastro-enterostomy, 2; anterior gastro-enterostomy, 1; anterior retro-colic gastro-enterostomy and splenectomy, 1.
Incision and drainage 1 case.	2 yrs., 1 case.	Pyloric obstruction, 1.	Posterior gastro-enterostomy, 1.
Reinforcement, 1 case	3 yrs., 1 case.	Ulcer, 1.	Posterior gastro-enterostomy, 1.

There are certain facts in the above tables which appear to justify emphasis:

1. For ulcers at the pylorus, posterior gastro-enterostomy is the operation of choice in the poor surgical risk, for, although pylorectomy is followed by better results, the operative mortality is distinctly higher. The cautery is a useful adjunct in selected cases.

2. For ulcers on the lesser curvature, cautery by the method described in a previous paper,[7] and gastro-enterostomy is the operation of choice.

3. Local excision alone of such ulcers is inadequate, 32 per cent of patients so operated on ultimately requiring further operative treatment, namely, gastro-enterostomy.

4. Sleeve or segmental resection, especially in large high ulcers and hour-glass contraction in suitable cases, is not only a relatively safe operation, but has been followed by good results.

5. The lowest operative mortality in the more common operations was associated with cautery and posterior gastro-enterostomy.

6. Ulcers on the posterior wall are associated with the highest operative risk, while those at the pylorus are of least risk.

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DISCUSSION ON THE TWO PRECEDING PAPERS

Dr. A. N. Collins (Duluth, Minn.): We have listened to two very interesting papers, and, in connection with Dr. Byron Davis' paper on "Perforations," I want to present a few slides illustrating a case of perforation *following* a gastro-enterostomy.

This case came to my attention some three years ago. It had a fatal termination, and I, fortunately, obtained an autopsy. I have some slides which I think will be very interesting to you.

This patient was a young woman, 28 years of age; a laundress by occupation, who for three years had symptoms at first pointing to a chronic appendix. The appendix was removed before the case came to my attention, and she ran along for two or three months, when we decided to do an exploration for the purpose of finding out the nature of the lesion of the stomach. At operation we found she had an indurated ulcer at the pyloric region. Unfortunately, my judgment was not good in this case. A pylorectomy would probably have been advisable. I did a posterior gastro-enterostomy, and she left the hospital in two weeks "improved." In six weeks she developed acute symptoms, vomited fecal matter, and died before we could get to her.

At the autopsy I found the following condition:

Upon opening the abdominal wall a perforation occurring anteriorly, at an entirely new point on the stomach, was first visible, and a fecal mass the size and shape of a lima bean showed through this perforation. Then turning the stomach over the gastro-enterostomy appeared to be patent and normal, and on the posterior side of the stomach a perforation into the colon was found. I took out the bowel, and this showed a perforation anteriorly. The jejunal side showed no signs of ulceration. This slide shows the gastrocolonic perforation behind, and shows the stomach side of the gastro-enterostomy, showing there is nothing to arouse suspicion.

In looking up the history of the case I found it was a rare condition. I found that one man had reported a case of rupture of stomach ulcer into the heart cavity itself—into the ventricle.

This is a diagram copied from a case which I found in the literature showing a perforation which followed gastro-enterostomy, where the colon became adherent at the point of gastrojejunostomy, and perforation took place into the

colon, showing the possibility of passing a probe through the stomach opening and across the lumen of the jejunum and on into the colon through the perforation.

Dr. R. C. Coffey (Portland, Oregon): The most interesting feature of perforating ulcer is the time at which the operation is done. One of the most classical papers ever presented on this subject was that of Weir, in 1900, at which time he reported 51 cases, with 7 recoveries. He reported only two cases of his own, and the others were collected from the literature. That looks as though bad surgery was done in those days, but it is not much worse than we do today when we consider the class of cases. All of the cases that recovered were cases that were twenty-four hours old or less except one. All the 44 cases resulting in death, except 1, were from thirty hours to six days after perforation. I looked over the entire literature on the subject and found over 50 per cent mortality, taking the whole literature together.

When we come to Deaver's statistics we find that he reported 36 cases of perforating ulcer, in 10 of which he refused to operate. In the 26 of these ulcer cases operated on he had one death, but he refused to operate on those patients in whom symptoms had existed for more thany twenty-four hours. More recent statistics are those of Sullivan, who in 20 cases had one death. He operated on his patients less than 14 hours after perforation had occurred.

The question is, how soon we can get them after perforation has taken place. If we go over the general statistics as the cases come to the specialist in the city, whose cases are referred, but are diagnosed and treated by the family doctor, we shall find the results almost as bad today as they were in Weir's paper in 1900. The mortality is almost entirely due to the time elapsed before we get the patients, and not so much to the technic of the operation.

I believe that Deaver has given us the best and most ideal technic of the treatment of perforation. The average surgeon, who is doing an occasional operation and is doing his own appendix work, but is not an expert in gastric surgery, had better not attempt a gastro-enterostomy afterwards. Gibson and other operators show that the question of the gastro-enterostomy is not as important as we think it is.

Recently, I saw a perforating secondary gastric ulcer. I operated, and found that the perforation in the case for which I had done a gastro-enterostomy a year before had entirely

healed, and there was no sign of the ulcer that had perforated the year before.

Concerning the subject of chronic gastric ulcer: While I have in the last six years done half of the operations with some kind of excision or radical operation, I am sorry for it, as my mortality statistics show I have made a great mistake by doing radical operations like excision; for, as Dr. Balfour has said, the excision operation will not do.

Dr. W. D. Haines (Cincinnati, O.): I think that the diagnosis of perforation of gastric or duodenal ulcer is very important, but it is sometimes very difficult. When perforation occurs it is in an emergency, and falls in the class of urgent surgery, and we do not have the time to devote to it that we do in non-perforated ulcer. The patient is brought to us, and we see him not infrequently on the operating-table for the first time. There is something ordinarily in the natural history of the disease which you can get from the patient if he can talk to you, he will tell you that he has had dyspepsia or that he could not eat certain kinds of food, and this will direct your attention to the stomach, duodenum, or appendix. By questioning him you will get a point of information here and there, and, ordinarily, I think, you will be able to make a correct diagnosis before opening the abdomen in all save a small percentage of the patients. I have seen cases in which every portion of the abdominal musculature was tightly drawn, and this is an important feature in the scheme of diagnosis. It means extensive peritoneal irritation, but it also means that the patient still has a chance. It is only after the nerve supply of the abdominal musculature is deadened by toxins that relaxation and great distention take place and the patient's chances for recovery are almost destroyed.

The second thing is, if there is any doubt whatever as to which organ is involved, place the incision so that you can readily command the entire field. With reference to the nature of the operation, more will depend upon the skill and celerity of the surgeon than upon any special type of operation.

I think the less you do consistent with getting a water-tight joint and draining the patient, the better. After all, our aim is to save life, and these measures will do so in many instances. We can do a secondary operation at some future time.

The introduction of salt solution at the time you begin the operation is an important aid. You can put enormous quantities into the loose cellular tissue of the axilla or give it intravenously. Have some one else do it while the operation is being done. The Surgical Shibboleth "Get in quick and get out quicker," finds its full measure of application in this type of work.

The doctor is right when he says that the occasional operator is not nearly so competent as the man who is doing this type of work constantly, but time is such an important element that the less skillful man will have more recoveries if permitted to operate within the first ten hours than will the highly skillful surgeon who sees the patient after eighteen or twenty-four hours have elapsed since perforation took place.

The doctor said that if these patients are operated on by a competent man within twenty-four hours after perforation has occurred, many of them can be saved. I would amend that by saying that the mortality increases by leaps and bounds after the first twelve hours.

We have not followed the practice of washing out the peritoneal cavity. We have been following the lead of Waterhouse, who, in an article in the *British Medical Journal* for February, 1914, described a method of pouring ether into the peritoneal cavity after establishing drainage. He puts in between 50 and 90 c.c. of ordinary ether in the peritoneal cavity. It is probably more or less empirical, but it does not wash out the protective lymph, and perhaps produces a lymphstasis, which retards the absorption of toxins. Our results have been satisfactory so far. We feel it is an added element which contributes toward getting the patient well. Morphia, oxygen, proctoclysis, and stomach-lavage comprise, in a general way, the post-operative management of these patients.

Dr. Archibald MacLaren (St. Paul): The Association is to be congratulated on having heard these two excellent and timely papers. We have all enjoyed both of them very much. The one on acute perforation by Dr. Davis appeals to me because we have seen quite a number of this type lately, and the diagnosis is not so difficult after you have seen one or two. They are so much alike that they slap you in the face. After having seen one of this type you will never forget it.

We have had the unusual experience within the past two weeks of having had a patient in the hospital ready for opera-

tion. The patient was being prepared to be operated on at eight o'clock the next morning, and at eight o'clock the evening before he had gone out to a barber-shop a block away from the hospital to be shaved, and suddenly collapsed while in the barber's chair. The symptoms were not as pronounced as usual. With the aid of one or two friends he was able to get back to the hospital, and was put to bed. Within an hour and a half of the perforation of the duodenal ulcer we opened the abdomen to find the tiniest opening that can be imagined in the center of an indurated plaque the size of half a dollar on the anterior wall of the duodenum. In closing this perforation because of the surrounding induration it seemed as though we could not avoid constricting the duodenum to such an extent that, for the first time in my experience, we felt justified in doing a gastro-enterostomy on top of a perforation. As Dr. Coffey has pointed out, the fact that this man was operated on within an hour and a half was in his favor. He had not been sick at all. It is our experience that the mortality increases after twelve hours, and that up to that time there is almost no mortality.

Dr. Leonard Freeman (Denver, Colo.): The two most important points for discussion are (1) What shall we do with the ulcer itself? and (2) Shall a gastro-enterostomy be done? Both of these things depend upon two factors, the condition of the patient and the situation of the ulcer. By the "condition of the patient" is meant his estimated resistance to surgical intervention and the amount of peritonitis present. By the "situation of the ulcer" is meant its location, anteriorly or posteriorly, or in the stomach or duodenum.

1. What shall we do with the ulcer?—In the body of the stomach it should be excised when the patient's condition permits, and when it is reasonably accessible; but this should not be done as a rule in the duodenum.

Excision is advisable in the stomach because it often can be done easily, because it gets rid of the ulcer, and because it prevents future cancer.

Excision is not advisable in the duodenum because it often is not easy, because it may cause stenosis and because the danger of cancer is negligible.

In any situation, if the ulcer is not excised, it should be infurled, if possible, and covered with omentum or other tissues when practicable.

In desperate cases, with much peritonitis, especially when

the ulcer is hard to reach, excessive manipulation should be avoided by packing around the ulcer, and draining externally without any attempt to close it. The less done the better.

2. Shall a gastro-enterostomy be done?

a. In stomach ulcers.—Considering that the utility of a gastro-enterostomy in ulcers of the body of the stomach is uncertain and that it adds to the operative risk, especially of patients with peritonitis, it should not be done except under unusual circumstances.

b. In duodenal ulcers.—Because of the curative effects of gastro-enterostomy and the danger of stenosis from infolding or from subsequent contraction, a gastro-enterostomy should generally be done in perforating ulcer of the duodenum, *providing the condition of the patient permits.* If, however, the patient's condition is unsatisfactory and mere infolding is liable to cause stenosis, it is better to pack off the ulcer, and let it go at that.

I do not believe it makes any great difference, in general, whether the abdomen is washed out or not. In the majority of cases of perforating ulcers upon which I have operated I have irrigated because I had reason to believe there was food in the peritoneal cavity. They have recovered. In some instances where I have not irrigated, recovery has also taken place. Where food is present I believe irrigation is often indicated.

Dr. M. L. Harris (Chicago): It will be remembered that a year ago before this Association a paper was read on excision of gastric ulcers in which excision was recommended as routine treatment for gastric ulcers. In the discussion of that paper I disagreed with the author for the reasons that excision of gastric ulcer was followed by an increased mortality, and that it was not followed by so high a percentage of permanent results as other methods. I took the position that posterior gastro-enterostomy, by reason of its very large percentage of permanent cures and its exceedingly small mortality-rate, should be the normal operation for gastric ulcer; and that any deviation from this normal should be the exception, and should be based on facts accumulated by experience. We should select other methods than posterior gastro-enterostomy for those cases which experience shows are not permanently relieved by posterior gastro-enterostomy, and particularly for those cases which show a probability of being malignant.

I am glad to see from the very extensive statistics shown here today and from the experience related by Dr. Coffey that that view is supported, and I think it will be supported by others who will analyze the end-results of excision. Posterior gastro-enterostomy should remain the normal operation for gastric ulcers, and some other operation should be performed as experience dictates in those cases which are not permanently relieved by gastro-enterostomy or which show a probability of malignancy.

Dr. H. E. Pearse (Kansas City, Mo.): I wish to speak briefly on a point in Dr. Davis' paper that has not been covered by the very free discussion we have had on a certain class of perforations, and that is the preventive measures possible when, as Dr. Davis said, we suspect perforation of the duodenum, and the after-treatment to promote the healing of it when it has occurred.

It is common for us to depend upon the control of nervous conditions for the betterment of secretory conditions in the upper abdomen; and I wish to call attention to the fact that while we all recognize that the active agent of perforation of the duodenum is largely the pancreatic secretions, yet practically nothing is undertaken to prevent the formation of excessive pancreatic secretions. These secretions are not called into activity, as are the secretions of the stomach, by the presence of food or the presence of any substance in the duodenum, but by the presence of acid acting upon the mucous membrane. The hormone that promotes activity of the pancreas will do this, when the nervous connection of the duodenum with the rest of the body has been severed. It will do this in all animals taken experimentally where the blood supply is anastomosed, and acid placed in the duodenum of one of them. The pancreatic secretions increase in quantity in the other; consequently we see how important it is to prevent the mechanical presence of acid in the duodenum if we expect to avoid perforation and if we expect to promote prompt healing at the close of it. That is one thing we should always remember. The administration of nerve sedatives and atropin has a tendency to increase the presence of acid in the duodenum by relaxing the sphincters. Whenever the "little stretching," which the doctor referred to as threatening perforation, occurs, it is well to fortify the duodenum against acid reactions by the administration of large doses of alkalies.

Dr. Van Buren Knott (Sioux City, Iowa): There are two points in the paper of Dr. Davis which I desire to discuss. In the first place, I was very much pleased with the view expressed that gastro-enterostomy should not be done in the ordinary case of perforation. Until a few years ago in nearly every paper read or in every discussion made concerning the procedure advisable in acute perforation of gastric ulcer, gastro-enterostomy was recommended as one of the essentials at the primary operation. Fortunately, this opinion has of late been considerably modified.

Patients who are the victims of acute perforation, are not dying because of poor nutrition. They are dying from peritonitis, and in many instances, if the operation, made to effect closure of the perforation and to institute drainage for the peritonitis caused thereby, is prolonged sufficiently to permit a gastro-enterostomy the immediate mortality will be increased.

I have had experience with several cases of perforation, in many of which it seemed that infolding or extensive suturing of the ulcer area was necessary. After such infolding or suturing was accomplished it appeared that so much stenosis of the pylorus or duodenum had resulted that a secondary operation, probably a gastro-enterostomy, would be necessary to insure complete stomach-drainage. I have never had one of these patients return for the secondary operation. It is, of course, possible that they may have gone elsewhere.

I do not believe that at the primary operation we may be certain as to the necessity, either immediate or remote, for gastro-enterostomy, and do believe that it may be more safely accomplished in the ordinary case as a secondary procedure.

As to the matter of drainage: I am glad that Dr. Davis advised drainage of the cul-de-sac or rectovesical pouch for perforations that occur in the general peritoneal cavity. For the ulcer situated anteriorly such drainage is much safer combined with the extreme Fowler position than attempts to drain the area immediately adjacent to the stomach. For posterior perforation taking place into the lesser peritoneal cavity, of course, posterior drainage at or near the costovertebral angle would be indicated.

I believe the advice of Dr. Davis, that the operation should be made quickly and nothing unnecessary done at the first operation, is absolutely proper.

Dr. Davis (closing on his part): I am very grateful for

the very free discussion you have favored us with, and I will be very brief. One word about Dr. Coffey's statement of "Deaver's statistics." I can appreciate the fact that any of us reporting nothing but early operations before any peritonitis has had time to develop, would probably be able to quote some pretty good statistics, and I can hardly conceive that Deaver is refusing to operate on these cases after twenty-four hours, because I recall two cases in my own experience where the perforation had occurred from thirty-six to forty-eight hours before I saw the patients, and both recovered and are in good health at the present time. If I had followed the plan which Dr. Coffey quotes Deaver as doing, those patients would have died.

It seems to me, although the ideal thing is to get these cases early, just as early as possible before there is any peritonitis developed, at the same time we have a duty to perform in regard to the patients that come too late, and I believe that, although the mortality increases by leaps and bounds from the beginning, even if we get a late case, if the patient is moribund at the time, it is our duty to do what we can, and occasionally there will be a recovery.

One other point I wish to discuss, and that is the matter of gastro-enterostomy. The only cases in which I have done gastro-enterostomy, and the only cases in which I have advised that gastro-enterostomy be done, are those that come so early that we can treat them very much as though the perforations were not there. Take a case that comes within a very few hours. I had occasion last spring to operate on a man, fifty-three years of age, for a peforation. I got him eight hours after the perforation had occurred. He was in a pretty fair general condition; it was a benign ulcer that perforated the duodenum. The patient was in such a condition that, after I sutured the ulcer, I felt justified in doing posterior gastro-enterostomy, just the same as I would in a case where we had no perforation. I had one other case of that kind. Both of the patients recovered. Those are the only two cases out of twelve that were typical gastric and duodenal perforations. In two of them only have I attempted gastro-enterostomy, and both recovered. If I had gone to work and had done gastro-enterostomy in some of the late cases, I have no doubt the mortality would have increased right along, and I am thoroughly in accord with those who advise against posterior gastro-enterostomy, unless the operation is done very, very early.

Dr. L. W. Littig (Davenport, Iowa): I would like to ask Dr. Coffey whether it is the practice of Dr. Deaver not to operate on these cases of perforation after twenty-four hours at the present time, or was that his practice some time ago?

Dr. Coffey: Dr. Deaver reported thirty-six cases within the last year or two, in ten of which he did not operate. This is not quite characteristic of Deaver. My recollection is, he operated on twenty-six, but of that number there was only one that went over twenty-four hours. In this case he got a good recovery.

As Dr. Davis has said, this condition of perforation is not much more than acute appendicitis, and if dealt with within the first twelve hours the mortality is not high, but after that time the mortality increases very materially.

Dr. Horace G. Wetherill (Denver, Colo.): Will Dr. Balfour explain to us what is meant by "sleeve resection"?

Dr. Balfour (closing): I am glad Dr. Coffey and the others who have discussed the paper agree on the point of excision of ulcer. Excision alone, however, is not the best operation, and I think Dr. Harris hit the nail on the head when he said that gastro-enterostomy is the indicated operation in gastric ulcer. But one should go further and say that, if the ulcer is accessible, excision or destruction with the cautery should be done along with gastro-enterostomy. We have had a number of cases in which we have resorted to the use of the cautery, and we find it safe and just as efficient, and especially valuable from the fact that it can be used where excision cannot be attempted.

As to Dr. Wetherill's question with reference to "sleeve resection": The term is probably open to criticism. I refer to the operation of resection in continuity of an entire segment of the stomach with the ulcer, and the approximation and end-to-end suture of the segments.

PERITONEAL ADHESIONS

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MINNEAPOLIS, MINNESOTA

Peritoneal adhesions are relics of past peritonitis, or are a result from mechanical or chemical trauma. They represent a conservative reaction on the part of the animal economy, and all are essentially benign in their intent. Should the formation of peritoneal adhesions be inhibited both abdominal surgery and recovery from intraperitoneal infection would be unheard of. The peritoneal adhesion has a mission to perform, and only when its function is exaggerated or perverted does it become an undesirable factor; therefore, the purpose of the research surgeon does not seem to point to their prevention, but rather to attain a better understanding of their natural history and to suggest means of turning them to useful purposes.

The attempt to prevent adhesions by inhibiting film formations with citrate, phosphorus, or peptone, while it may for a time postpone scar-tissue formation, does not seem advisable for the following reasons: The use of citrate particularly makes the control of hemorrhage difficult; and, according to Sweet, Cheney, and Wilson, it tends to disseminate infection, and interferes with repair. In case of survival of the animal it does not always prevent adhesions. The modification of the citrate method, as suggested by Pope, by using it on gauze packing, seems an unsatisfactory compromise. In many instances too much energy is

wasted in attempts to cure adhesions by the knife. Therefore, this paper will discuss the causes of adhesions, the natural courses of development of an adhesion, whether it is possible to permit of its development, and, finally, as to what surgery can do to relieve the symptoms that come from adhesions by controlling the direction of their occurrence.

Before attempting these problems one must know the character of adhesions. By the term "adhesion" a great variety of pathological conditions is included. In the broadest sense the term adhesion includes everything from peritoneal agglutination to the true adhesions made up of connective tissue with definitely organized blood-vessels. For practical purposes an adhesion is a definite organization of scar tissue between two or more structures. In addition, we may have scar tissue in the visceral peritoneum without adherence to any other structure. This may be demonstrated by gauze-stripping of the intestine with almost the same results obtained by Wegner, who studied the changes in the endothelium of the peritoneum after trauma with the air-blast. These changes range from fatty degeneration of endothelium with subsequent desquamative change to ultimate connective-tissue replacement.

Hertzler has shown that limited destruction of endothelium resulted in agglutination, but when the trauma reached to the subendothelial connective tissue that true scar-tissue proliferation took place together with vascularization. Hertzler emphasized the important rôle of inhibition of peristalsis in the statement that "irritation of an intestinal wall with the point of a needle after primary increase of peristalsis is followed by a lessened peristalsis. Following the temporary paralysis the adhesion occurs. The first step in the formation of the adhesion is exudation of serum and

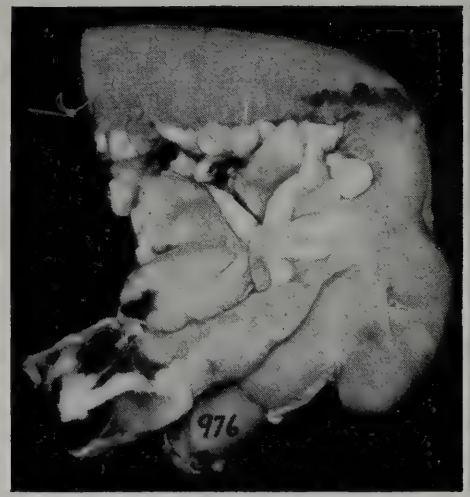


Fig. 1.

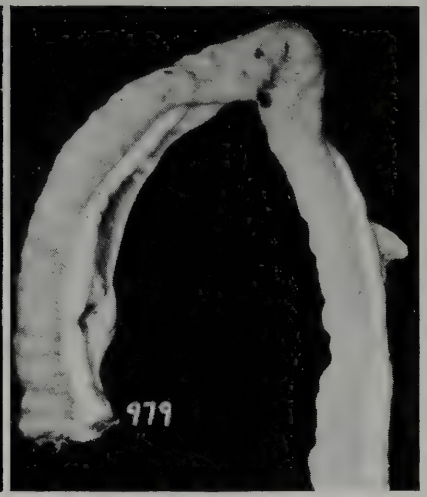


Fig. 2.

Fig. 3.

Fig. 1. Specimen 976. Illustration of the tendency adhesions have to disappear. Two surfaces of intestine were scratched with a needle-point in a straight line, and sutured along the line with fine sutures reaching into the muscularis. These, examined soon after the operation, showed dense adhesions along the suture-line. At autopsy they had completely separated.

Fig. 2. Specimen 979. Illustration of the tendency of adhesions to disappear spontaneously. Two surfaces of intestine were scratched with a needle-point in a straight line, and sutured along the line with a fine suture reaching into the muscularis. These, examined soon after the operation, showed dense adhesions along the suture-line. At autopsy they had begun to separate. Operation May 26, 1916. Autopsy September 7, 1916.

Fig. 3. Specimen 984. Repair by formation of scar-tissue, without adhesion, in visceral peritoneum. Both the parietal and the visceral peritoneum had been abraded with gauze until bleeding occurred. Operation September 25, 1916. Autopsy October 6, 1916.

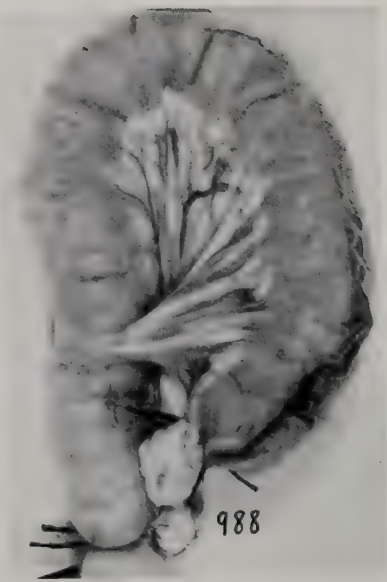


Fig. 4.

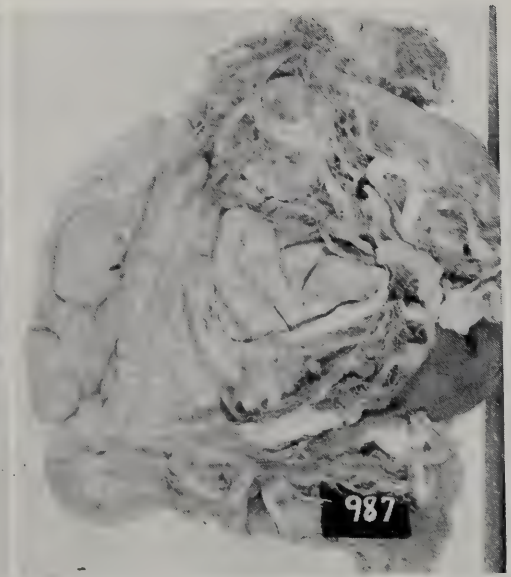


Fig. 5.

Fig. 6.

Fig. 4. Specimen 988. Adhesions following hematomata in mesentery. Two hematomata were made October 28, 1916, in the mesentery of the small bowel. It was found at autopsy, November 17, 1916, that both of these had formed adhesions.

Fig. 5. Specimen 987. The cure of adhesions with the knife. This animal had numerous adhesions between the coils and the mesentery of the bowel without the involvement of the omentum, as the result of the faulty intestinal anastomosis. On September 28, 1916, the adhesions were separated by sharp-knife dissection. The plate shows the condition on October 28, 1916, at the autopsy.

Fig. 6. Specimen 721. The plate shows the effect of cutting intercostal nerves on repair of the peritoneum. Analogous to the section of nerves in the right rectus incision. (Quain experiment.) The midline incision. The peritoneum is scarified on either side, and the intestine allowed to dry, and handled with gauze. The ninth, tenth, eleventh and twelfth nerves are cut on one side. Operation April 8, 1915. Autopsy May 20, 1915. Adhesions were limited to the denervated areasof the peritoneum.

change in the endothelial cells. The exudated serum coagulates and forms fibrin, particularly at the edge of the process. At the same time that the fibrin-formation is taking place, polynuclear leucocytes escape into the coagulated mass. Within a few hours round cells collect in the fibrin mass. At this time the fibers of the basement membrane begin to loosen, and different fibers become entangled with those of the opposing layer of peritoneum. The fibrin-formation at the beginning appears to remain, and serve as a scaffolding for the subsequent process."

Clinically, as well as experimentally, it has been our observation that there seems to be a direct ratio between the amount of fluid in the inflammatory exudate and the density of the subsequent adhesion. Hertzler calls attention to the greater tendency of adhesions to form subsequent to operative procedure on the lower ileum as contrasted to the jejunum. This probably is a result of the difference in bacterial flora of the upper and lower bowel. It has been my observation in some two hundred intestinal anastomoses that any invasion of the lower bowel was almost sure to be followed by adhesions, while the jejunum and duodenum could often be entered without any such consequence.

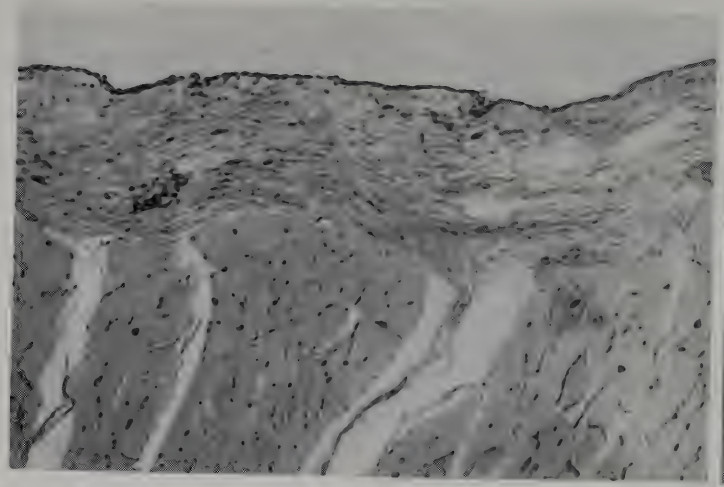
The causes of adhesions are given by Murphy as chemical, mechanical, or infective. For purposes of presentation we will first consider the rôle of aseptic trauma. From our own work the etiological significance of pure uninfected trauma seems to dwindle. When taken in connection with infection no one can doubt the importance of this element. All of our experiments emphasize the importance of the traumatic factor when taken in conjunction with infection, but minimize it per se.

To determine the effect of sterile trauma a series of experiments was undertaken. Sterile section of the

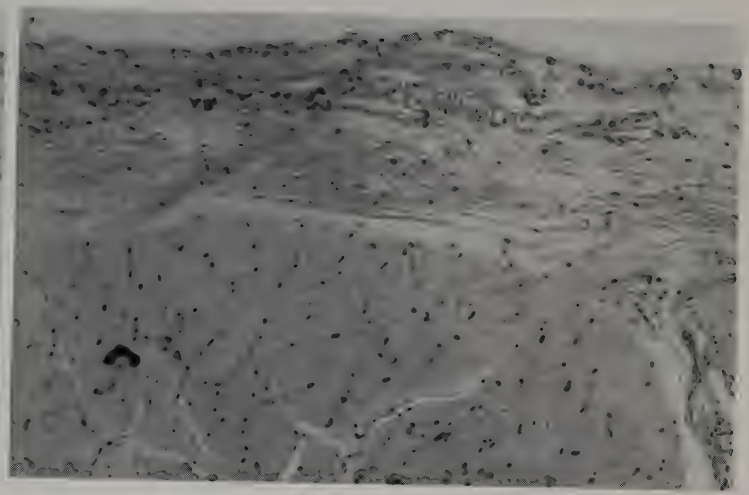
abdomen was done in a series of dogs. In these animals the parietal peritoneum and the peritoneal coat of the ileum were abraided with gauze until they bled. The laparotomy wounds were then closed, and the animals were allowed to recover for varying periods of time. At the autopsies there were seldom any adhesions either to the omentum or viscera. The peritoneum usually was found glistening and of normal appearance. Microscopic section showed normal investment with endothelial layer. The visceral peritoneum did not seem to present the same appearance. While there were no adhesions between the viscera, yet the peritoneum over the ileum often showed patches of scar tissue. These results were somewhat analogous to those of Dembowsky, who traumatized by means of a sterile tooth-brush. Vogel's results with cautery were accomplished with no marked adhesions, but are not identical in that superficial cauterization did produce adhesions, while black burns did not. Sanger's experiments, where six centimeter defects in the peritoneal wall of dogs had been produced, naturally resulted in adhesions. These, so often quoted, can hardly be used as an illustration of ordinary mechanical traumatism. However, other observers have found that even stripping the parietal peritoneum did not often cause adhesions if the work was done aseptically.

Sterile gauze when left in the wound undoubtedly causes adhesions.

The use of catgut has been acquitted of the charge of producing adhesions; yet it is true that linen sutures produce typical anatomical adhesions. A series of experiments was done with adhesions produced by continuous linen suture, and these were studied to determine something of the life history of an adhesion. For this purpose two opposing peritoneal surfaces of



A



B

Fig. 7. Specimen 795, showing the importance of a nerve supply in the repair of denuded peritoneum. A. (A left.) Section taken to show the repair of the peritoneum over the defect made in the peritoneum with a tooth-brush in the presence of infection. The nerves in this side were intact. B. Section taken to show the lack of repair of the peritoneum over the defect made in the peritoneum with a tooth-brush in the presence of infection when this area had been denervated.

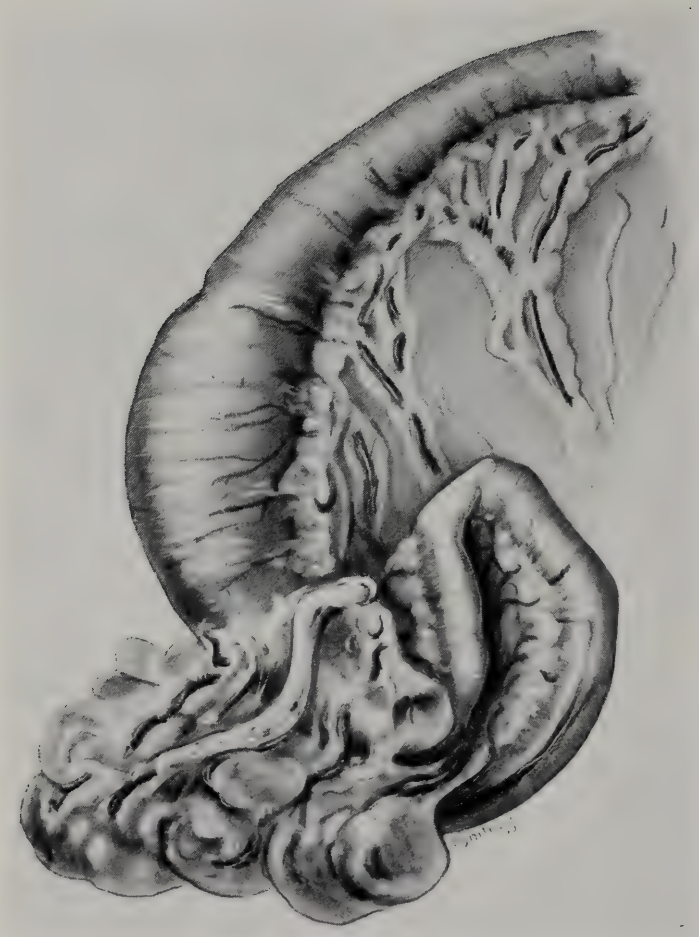


Fig. 8. Specimen 989. A piece of celloidin membrane was wrapped about the bowel. Note the adhesions and partial intestine obstruction.

the ileum were sewed together with linen. The sutures reached only to the muscularis, and were very carefully placed. After such an experiment, at the end of two weeks the line of suture was densely adherent. Histologically, the adhesions differed from no other adhesions. As these animals were repeatedly subjected to laparotomies it was found that the adhesions stretched out and finally disappeared. This occurrence had its counterpart in adhesions from other causes, but this was used in that it offered a means of accurately recording the changes that took place, and permitted measurement in centimeters. On the other hand, the changes in unlimited adhesions, or the changes in adhesions from infection, could not be accurately recorded, but were a matter of memory and judgment. Therefore, this type of adhesion was used in detailing the natural history of these structures. As the adhesions stretched out, their blood supply became less and less, and to this was attributed the cause of their disappearance. Clinically, we know that the victim of painful adhesions is only relieved temporarily by operation, but the trouble is very apt to return, while he may recover if these adhesions are left to their own natural life cycle. These same suture lines when distributed by attempts to break them up would be followed by increased production of new adhesions; however, we sometimes found that suture adhesions did not disappear. Usually, in such cases the omentum was found plastered to the suture line. The persistence of these adhesions could be explained on the ground of blood supply, as this is usually deficient in adhesions, and the omentum readily furnishes surrounding viscera with a new blood supply. Therefore, aseptic trauma of normal parietal and visceral peritoneum does not seem to be followed by permanent

adhesions unless the cohesion is augmented by the omentum.

In connection with sterile trauma, Dr. E. P. Quain has given a very important contribution to the prevention of adhesions. Part of his work was clinical observation, and part of it a series of experiments carried out at the University of Minnesota. In his experimental work the parietal peritoneum was massaged by a tooth-brush and the results noted. In animals where both sides of the peritoneum had been so treated, adhesions were the rule only on the side where the intercostal nerves had been sectioned. Moreover, in some of his experiments that we repeated we found that defects in the parietal peritoneum did not cover with endothelium when the intercostal nerves had been sectioned. Further than this, in many of our right rectus incisions where several of the nerves had been cut we found adhesions that were limited to the denervated area. Therefore, nerve supply seems an important factor in the production of adhesions. Infection alone in our series did not produce as severe adhesions as occurred in infection plus trauma.

Much stress has been laid on the importance of good surgical technic in avoiding adhesions. Wegner and Walthards have shown the deleterious effect of drying of the peritoneum; hence, the value of rapid operating. Thompson has shown the effects of a dry gauze left in the tissues. Moore has warned against drainage tubes in that they give access of extraneous infection to wounds; therefore, drainage should be done only when absolutely necessary. Crile and Carrel have demonstrated the value of delicate handling, and the necessity of avoiding all unnecessary gauze manipulation, together with the value of perfect hemostasis. Strassman has called our attention to the effect of hematoma in producing adhesions, and the futility

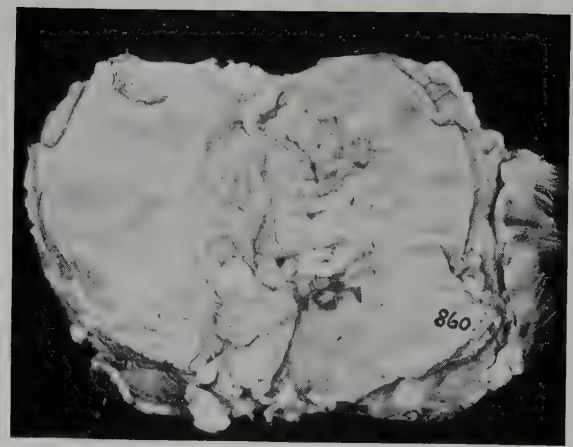


Fig. 9.

Fig. 10.

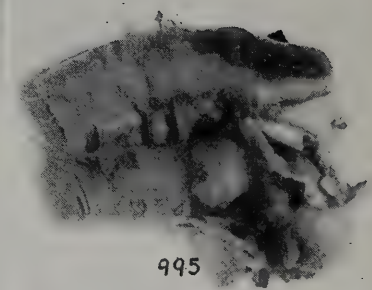


Fig. 11.

Fig. 9. Specimen 860. Free transplant of omentum to cover raw places subsequent to separating adhesions from the anterior abdominal wall. Operation December 12, 1915. Autopsy December 18, 1915. No visceral adhesions to transplant.

Fig. 10. Specimen 1047. The use of ether in the prevention of adhesions. A hole was made in the terminal ileum, and 8 c. c. of intestinal contents allowed to escape. Ether was placed in the peritoneal cavity, and the laparotomy wound was closed. Operation November 16, 1916. The specimen was recovered by operation November 28, 1916. Adhesions were generally absent. The omentum was fastened at one place to the bowel.

Fig. 11. Specimen 995. Use of ether in the prevention of adhesions. A hole was made in the terminal ileum, and 8 c. c. of intestinal contents allowed to escape. Ether was used as a lavage, and a small amount was left in the peritoneal cavity. Operation November 21, 1916. Autopsy December 7, 1916. Two coils of intestine were found bound together with web-like adhesions.

of pedicle stumps has been epitomized by Stimson. Their predilection to cause adhesions is a matter of common observation.

All of this is so familiar that the repetition is banal, but the handling of the infective agent, *per se,* is usually left to itself and has received but little consideration by the experimental surgeon. I do not wish to minimize the importance of technic but in addition to emphasize the importance of infection in cases where both infection and trauma are combined.

Operations often have to be done in the presence of infection already in the peritoneal tissues, or infected hollow viscera have to be invaded. The density of adhesions with any standard operation carefully performed with due regard to the principles of operative surgery seems to be usually in direct proportion to the amount and character of the infective agent. For instance, in intestinal work the result depends very largely on the flora of the particular region and the amount of that flora that is allowed access to the peritoneum. The important etiological rôle of infection in producing adhesions suggests the necessity for some effort to combat infection in the peritoneal cavity. So far the efforts of the surgeon have been directed more toward selecting the proper time for operation, to selecting advisable routes to the seat of infection, and to the refinements of technic, rather than to combating infection directly. Besides this, advantage has been taken of acquired immunity, but very little has been done in regard to chemical disinfection. Some substances have been tried and condemned; others are yet on trial. Tincture of iodine, recently advocated by Crisler, does not seem to be generally accepted. With our work a two per cent solution of iodine painted on the infected peritoneum did not always produce adhesions, but the three and a half per cent and

seven per cent always did. Carbolic acid, salicylic acid, and bichloride of mercury have all been justly condemned, except when used to sterilize minute pedicles. Normal salt solution in the peritoneal cavity has been recently championed by Clark, and certain experimental evidence has been produced to show that animals are less subject to peritonitis when the inoculating material is diluted with normal salt solution than when not so diluted. The use of saline as a lavage has had but little effect in lessening peritonitis, as evidenced by post-operative adhesions in our hands. All of the strong antiseptics seem to do harm in the peritoneal cavity and to intensify peritonitis rather than inhibit it. Ether alone offers a possible exception. Hertzler produced adhesions with ether in the peritoneal cavity. For that reason and for its toxic effect, skepticism in the use of that agent is justified. However, ether in our laboratory has not produced permanent adhesions when used alone in the cavity. Clinical usage has promoted the use of ether in combating peritoneal infection. This might be interpreted as meaning the prevention of adhesions. This has received attention from Souligoux and Morestin. Reports favorable to its use appear by De Tarnousky, Dergnanc, Waterhouse and Phelip, Tartois, and Lundholm.

In the experimental laboratory the use of ether following escape of infective material onto the peritoneum does seem to lessen the formation of adhesions. To demonstrate this with the idea of eliminating, as far as possible, the question of complicated technic, a series of animal experiments was done. In these experiments a hole was made in the lower ileum, and the contents of the bowel were allowed to escape. Then the hole was closed, and the infectious matter was washed out with ether. Some ether was allowed to

remain in the cavity. As a result of these experiments general adhesions were found absent, and oftentimes only a little of the omentum had attached to the bowel sutures. Some of these experiments with ether were followed by adhesions. These usually presented a stretched-out appearance. It is true that in some of the controls where ether was not used the adhesions were no more dense, but this was not the rule. Guy-rope adhesions seemed to be more common after the use of ether than without it. In some instances ether seemed to prevent adhesions; in other instances, at least to mitigate them. In addition to this, with intestinal anastomoses fewer adhesions developed, as a rule, after the use of ether lavage than did without it. It is difficult to substantiate the claim that ether is an antiseptic of sufficient power to destroy infection. Ether is usually vaporized in the peritoneal cavity after a very short time. Test-tube experiments by Topley with agar cultures required a three-hour contact with ether vapor to kill bacillus coli and streptococci, while the staphylococcus required five hours. On the other hand, suspensions of bacillus coli in liquid ether were practically destroyed after one minute shaking. As to the advisability of the use of ether, Saliba reports favorably on its use in 240 cases of peritonitis. In this series ether poisoning was encountered twice and one of the cases was complicated by pneumonia. Waterhouse has reported 60 cases, with two of ether poisoning and two of pneumonia. The work of these men has established the proper dose of ether in the peritoneal cavity. It should never be more than half an ounce for children under two years, and three ounces in adults; larger doses produce ether poisoning.

In combating infection some mention must be made of the cautery. Cautery burns, if properly made, do not produce adhesions, and the cautery is justified

whenever it is possible to use it in cutting through infected tissues.

Sterile blood is ordinarily very rapidly absorbed from the peritoneal cavity without clotting, as is shown by Hertzler. The rate of absorption has been shown by Buxton and Torrey. However, infected blood does not act in this manner, and Hertzler states that blood-clots are not so benign. In our experiments when sterile blood, or even blood-clots, were allowed to remain in the abdomen marked adhesions did not follow. However, hematoma in the mesentery of the bowel almost invariably was followed by dense adhesions. To illustrate that, a simple needle puncture was made in the mesenteric vessel, and hematoma allowed to form. No hemostasis except gentle pressure was employed. Invariably subsequent section showed these hematomas to be definitely attached to some surrounding structure. Strassman has also considered hematoma as predisposing to adhesions.

The omentum may perform a benign function or an unfavorable one. Neuhof and Weiner have shown that the omentum, and particularly the free edge of the omentum, has the power of being insinuated in needle-hole punctures, and finding attachment there. They also found that the free uncut edge of the omentum had a predilection to cover any raw or infected surface. This is benign in preventing adhesions between viscera and to the parietal wall, or, at least, has the advantage of making them more mobile. However, in cases when the omentum attaches lower down in the pelvic region it may produce trouble by traction on the transverse colon. This emphasizes the necessity of utilizing the omentum to advantage so that it may cover raw surfaces without extra traction. Clark has called attention to certain important facts in selecting the field for our adhesions to occur. Clark

emphasizes these principles: Traction on the omentum may drag down the colon or the pyloric end of the stomach, or convert the superior mesenteric artery into a constricting band. The resulting deformities cause symptoms. Further, adhesions near the small bowel, except at the duodenal junction and at the pelvic portion of the ileum, are not likely to produce symptoms. Kinking or adhesions of the large bowel to the parietes, or adhesions of the small bowel to the parietal peritoneum, are capable of producing symptoms. This partly answered the question of the advantage of postural treatment during convalescence. In addition, if the organs must be fixed there seems to be some advantage in fixing them in such a position that pain will not occur when the patient is standing. The Fowler position in a measure accomplishes this; and, in addition, Clark advocates weighting down the sigmoid and the rectum with fluid. When adhesions are unavoidable, we may gain much for the patient by selecting the proper site for them. This is emphasized by Reichelderfer in postural treatment. In support of this he cites a case of a girl who had been operated on ten times for adhesions. He directed his efforts toward postural localization of adhesions, accomplished by allowing the patient to convalesce in the sitting position. After her last operation she was free of any unpleasant symptoms.

The utilization of the omentum is desirable if it can be done without producing traction; therefore, the free omental graft first described by Senn, and later in full development treated by Freeman and Mann, commends itself. To determine the exact fate of the transplanted omental graft Dr. John Halgren, of the University of Minnesota, conducted a series of experiments. These were awarded the prize in Surgery, but have not as yet been published. Halgren's studies

showed that the omentum could be transplanted, and that the transplanted omentum gave up its fat and finally became a mass of connective tissue. The omental transplant did not give a smooth peritoneal surface in any case. Adhesions about the transplanted omentum invariably occurred, but they were benign adhesions in that they were mobile, and never caused obstruction or traction on painful structures, such as the parietal peritoneum or mesentery. He further found that their use in the presence of infection is undesirable, as sloughing of the entire mass will occur. Therefore, their use seems limited to covering raw surface, and to give mobile adhesions between anatomical structures. The use of the omental graft seemed very superior to the use of other substances, such as Cargile's membrane or Prime's celloidin membrane. Both of these substances produced adhesions, and in the presence of infection greatly augmented the infection. Craig and Ellis, after experimental work, do not approve of the same.

Oil in any of its forms does not seem to prevent adhesions except when it is used as a covering to silk packing-material. Sweet, after careful investigation, has objected to oil in that it seems to disturb the function of the leucocytes. Gellhorn, Blake, Claypool, and Wilke have given various explanations for failure of some particular oil but do not agree as to what the proper substance may be.

I wish to acknowledge the assistance that Mr. A. D. Hawkins has rendered me in performing some of the special experiments.

CONCLUSIONS

1. Adhesions are benign in their intent, but may become perverted.

2. Adhesions, if left alone, tend to disappear spontaneously.

3. Of the various etiological factors infection seems to be the most important.

4. Trauma intensifies the effect of infection.

5. Ether seems to be the most satisfactory chemical means of combating infection. It is not devoid of danger, and is not always effective.

6. Postural treatment is an important question in minimizing the symptoms of adhesions.

7. Omental grafts may be used in covering raw surfaces, but should never be used in the presence of infection.

8. The use of citrate and oil does not seem to be justified.

9. Foreign bodies, such as Cargile's membrane, in themselves produce adhesions, and oftentimes very undesirable adhesions.

10. Hematomas are a cause of adhesions.

11. The cautery is a useful agent in preventing adhesions.

12. Section of nerves as may occur in the right-rectus incision predisposes to adhesions.

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FOR DISCUSSION SEE PAGE 136

THE NATURE AND GENESIS OF PERITONEAL ADHESIONS*

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By adhesions in the sense of this monograph is meant the more or less permanent attachment of two peritoneal surfaces. In this sense the healing of the serous coats of the intestine in anastomosis is an adhesion. This, in form and substance, is in marked contrast to the indurated mass which forms about an infected area, as, for example, an inflamed appendix. The first corresponds to healing by first intention, while the latter corresponds to healing by second intention The first is characterized by the formation of permanent scar tissue, while the latter is formed by unorganized granular débris, which later becomes absorbed. Adhesions may be classified, therefore, as permanent and temporary. In each of these there is a definite series of phenomena involving all the layers of the peritoneum.

In contrast to the above it may be noted that when the peritoneum is subjected to very slight irritation the surfaces may become attached to each other by virtue of changes in the viscid fluid normally covering the peritoneum. Such attachment is temporary and purposeless. For want of a better term this may be called *agglutination.*

Peritoneal Agglutination.—The difference between

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the changes noted in agglutination and the initial stages of adhesions consists in that in the former the attachment is brought about by coagulation of the fluid normally covering endothelium unaccompanied by deeper changes. In other words, there is no evidence of irritation manifested by vascular dilatation and exudation, but the process is played in the alteration of the surface secretions normally present. There result fine fibrin bridges between the surfaces of the endothelial cells that look on cross-section like cilia. (Fig. 1.) With greater irritation the cells may become thickened so that they are cuboid or even columnar. A prolonged exposure to the air may produce these agglutinations. They may be observed in abdominal operations where a dry pack has lain against a gut for a considerable length of time. The same thing is observed when two serous surfaces lying in contact are exposed to the air. When separating such surfaces with the fingers the sensation experienced reminds one of the crackling of an automobile tire running on a slightly muddy street.

These agglutinations may temporarily hold gut surfaces in light apposition. As soon as the parts are returned to their normal environment the secretion of the serosa increases and the surfaces free themselves. Permanent adhesion does not take place because these uniting bands are never composed of fibrillar fibrin and hence are incapable of forming fibrous tissue which alone can form a permanent union.

In order to study the fate of these early changes I sewed a window in the abdominal walls of animals (see "Peritoneal Adhesions: Their Cause and Prevention," Tr. West. Surg. Assn., 1904, xiv, 76) so that the process could be directly observed. By this means it is possible to observe that, when left to themselves, these agglutinations release themselves within a few

hours. An artificial excitation of peristalsis hastens it, as does the excitation of peritoneal exudates.

In this process there are none of the active factors present which indicate the initial processes of adhesion-formation. There is no change in the intercellular substance, and no change in the connective tissue of the basement membrane. (Fig. 1.) Some of the agencies producing agglutination if continued may produce reactive processes, which would result in permanent adhesions. To produce such a result their duration beyond the requirements of any operation would be demanded. Drying for less than six or eight hours will not produce it, and contact with dry gauze must endure more than four hours before more than a temporary agglutination is excited.

Graser ("Die erste Verklebung der serösen Haute," Arch. f. klin. Chir., 1895, L, 887) does not distinguish between these simple agglutinations and the early stages of the adhesion processes. In consequence many surgeons, reasoning from the premises, instituted various means calculated to excite peristalsis in order to break up these supposedly initial processes. As a result, undoubtedly, many unnecessary post-operative bellyaches have been caused. Hence the value of a correct interpretation of the simple process now under discussion.

Prenatal Adhesions.—In the course of the evolution of the intestines certain attachments of surfaces previously free take place. Although the attachment follows a general plan there are variations over rather wide limits. In some instances the limits of these attachments seem to exceed the normal, and are then referred to as adhesions. Clarke ("Surgical Considerations of Congenital and Developmental Defects Leading to Obstinate Constipation," Jour. of the A. M. A., 1910, lv, 449) has recently considered these,

and he regards them as potent factors for future trouble. Flint ("Embryonic Bands and Membranes about the Cecum," Bull., Johns Hopkins Hosp. 1912, xxiii, 302) also has discussed them, and recognizes them as legitimate variations. The most of these variations have been referred to in the section on anatomy.

It is unfortunate that the term "adhesions" should have ever been applied to these variations, for the term suggests to the surgeon something abnormal and baneful.

Before the recent campaign to discover anatomic causes for constipation, such variations in gut attachment were frequently ascribed to fetal peritonitis. These are discussed in a separate section.

Since our knowledge of the pathogenesis and clinical consequences of these variations is at present wholly unsatisfactory, the sole interest in these centers in the determination of the method pursued in the obliteration of serous surfaces in development. When these adhesions occur, as in the fixation of the cecum to the parietal peritoneum, the serosa, as previously noted, has not reached its full development. The endothelium is low and cuboidal, and the basement membrane is illy formed, while the membrana propria is a cellular mass of undifferentiated cells. When in this state a fusion is a simple matter, and is in nowise comparable to any process observed in the adult. In other situations, as in the mesosigmoid, a more mature state is reached before the surface becomes attached, but here also none of the phenomena observed in the adult can be detected. It may be said, however, that the cells disappear and the two basement membranes coalesce without the formation of any demonstrable new fibrous tissue. As already noted in the section on anatomy, the causes of this fusion are not yet understood. Whether pressure of opposed surfaces has

anything to do with it, is difficult to say. Fusion can be caused by pressure of two opposed peritoneal surfaces between two plates, but this does not prove that pressure has anything to do with the normal process which obtains at the time of development.

When the whole problem is reviewed from the anatomical, as well as a physiological, standpoint it must be apparent that there is almost no limit to the range of variability of attachment of the various organs compatible with physiological function. The most astonishing variations are not infrequently found in bodies which caused no inconvenience to the individual during life. That they may aggravate diseased conditions, as suggested by Clarke (l. c.), may readily be accepted, but to ascribe to them all sorts of baneful influences manifesting themselves late in life is obviously apt to lead to serious error. My own studies have convinced me that these variations are like noses, —great variations in the normal state pass without comment, but when reddened and inflamed at once excite comment.

Permanent Adhesions.—The processes incident to the formation of permanent adhesions are identical with those of wound-healing; therefore, in order that an adhesion shall be permanent there must be sufficient irritation to produce an exudate capable of forming fibrillar fibrin. The material capable of producing this must come from beneath the endothelial cell layer. It is necessary, therefore, that a considerable degree of injury to the serosa be inflicted before these processes are set in motion. Such a degree of irritation may be produced by a severance of continuity, as by an incision of the peritoneal surface during an operation. An abrasion due to blunt violence sufficient to destroy the surface endothelium acts in the same way. A great variety of diseases, as is well known, involving

the peritoneum, may produce adhesions. Chemicals, also, such as antiseptics, may set up reactive processes that result in adhesions. As a matter of convenience, therefore, permanent adhesions may be classified into those produced by diseased processes and those which result from mechanical violence. The latter may be divided again into those the result of accidental trauma and those due to injury produced by the surgeon.

Adhesions Due to Disease Processes.—Adhesions due to disease processes may be produced by any condition which excites the formation of a coagulable exudate on the surface of the peritoneum. This implies that the irritation must be of moderate intensity, for most disease processes excite an irritation in excess of this degree and produce an exudate which forms a granular instead of a fibrillar fibrin, hence only temporary adhesions result.

The genesis of these conditions can be imitated by experiment. If a pledget of gauze or any other unabsorbable body is placed in the peritoneal cavity it at once causes adhesions to form about it. (Fig. 2.) The irritation produced by an extraperitoneal disease is most nearly imitated by placing a gauze pack against the parietal peritoneum without opening the abdominal cavity. In this instance the gauze causes a reactive inflammation in the parietal peritoneum, just as a disease process would. This reaction is transmitted to such abdominal viscera as may be lying near the point of irritation, and causes their adhesion to it. (Fig. 3.) One sees that this experiment imitates very closely an inflammation of the gall-bladder due to the presence of stones. The stone irritates the gall-bladder wall setting up a reaction which is, in turn, transmitted to the adjoining peritoneal surfaces, and causes their adhesion to it and to each other.

If the foreign body in the experiment is infected by

Fig. 1. Cillia-like processes after slight irritation of the gut-wall.

Fig. 2. Adhesion of the colon to the parietal peritoneum of a rabbit caused by a pledget of gauze placed in the abdominal cavity.

Fig. 3. Omentum adherent to the abdominal wall, the result of aseptic peritoneal irritation produced by placing a pledget of gauze over the parietal peritoneum and under the abdominal muscles without opening into the abdominal cavity.

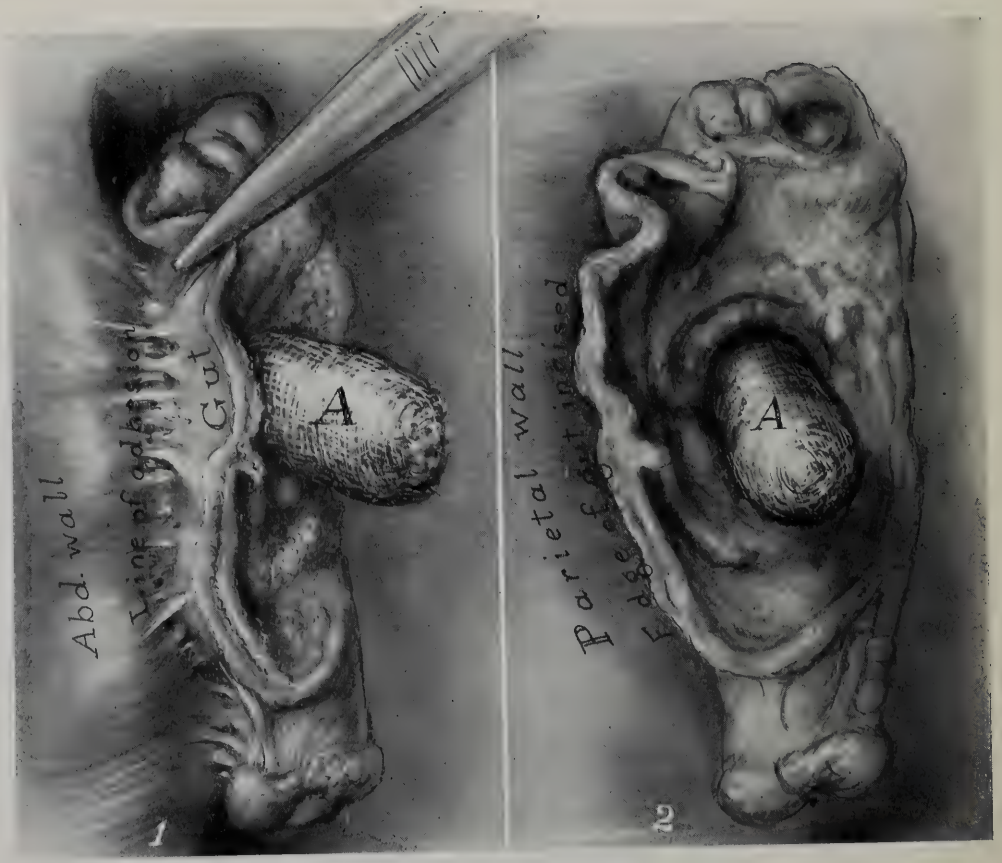

Fig. 4. A pledget of gauze was placed loose in the abdominal cavity. The gut-wall which encapsulated it has become ulcerated through, and the gauze appears in the lumen of the gut. *1* shows the density of the adhesion of the gut to the wall; *2* shows the gut-wall split open to show the protruding gauze.

soaking it in a culture of pyogenic bacteria or in intestinal contents, an ulcerous process is excited. This may be so great as to cause the foreign body to be extruded into the lumen of the gut. (Fig. 4.) It does not require a heavy tax on the imagination to see the protruding gauze pledget in the figure as an enterolith or a gall-stone escaping from the infected cavity in which it lay.

The chief interest centers in the determination of those conditions which determine the permanency of the adhesions. In general terms, it may be said that, in order that the adhesion shall be permanent, the reaction must not have been sufficiently great to prevent the formation of fibrillar fibrin. This generally means that there must not have been an actual escape of bacteria. When there is a greater irritation, as from the escape of pus-producing organisms, the immediate region of the more intense infection is surrounded by temporary adhesions, while, at some distance from this point where the infection is less intense, permanent adhesions may form. After a disease has run its course the interpretation of past processes may cause some confusion. For instance, in an appendix in which the chief site of irritation is at its base, large massive omental adhesions occur at this point at the height of the process, which are temporary in character. At some distance from this, say at the level of the lower pole of the kidney, the irritation may be just sufficient to produce a plastic exudate. At this point, therefore, remote from the chief site of infection, then the adhesion is permanent. (Fig. 5.)

The relation of permanent adhesions to the more intense infections may well be studied in the case of the foreign body experiment represented in Fig. 4. At first over the site of the foreign body an exudate of fibrin is thrown out. This, being invaded by bac-

teria, cannot produce fibrous tissue. The irritation produces more exudate farther away from the point of maximum irritation, which at some point is sufficiently infiltrated with defensive factors to wall in the infection. External to this zone a layer of fibrin is then thrown out, which, being protected from the invasion by the protecting wall just noted, is able to form fibrous tissue. As a final result the central zone above mentioned, by virtue of the intensity of the infection, liquefies, destroying the wall of the gut, and a perforation ensues, while a general peritoneal infection is prevented by the more remote zones of adhesion. The outermost of these zones becomes a permanent fibrous tissue union. If a permanent fistula results a fibrous tube covered by peritoneum remains. If the fistula heals only a fibrous cord covered by peritoneum remains as a permanent reminder of a serious condition successfully withstood. These zones may be represented by a schematic drawing. (Fig. 6.)

The various steps represented in the above experiment can be traced with variations in impending perforations of many disease processes, for instance, in enteroliths or gall-stones. Instead of the perforation being direct into a hollow viscus, complications, such as the formation of abscesses and secondary complications due to these abscesses, may ensue. In fact, in most instances, not a fistula but a localized abscess is the immediate result. If the process stops short of perforation only the first step in the process may be reached, as represented in Fig. 3.

Similar processes can be traced in more complex conditions, such as one observed over chronic ulcers, as of the stomach and duodenum. The various possibilities may be outlined as follows: Immediately over the ulcer the reaction, if mild, excites the peritoneum to the formation of permanent adhesions. In this

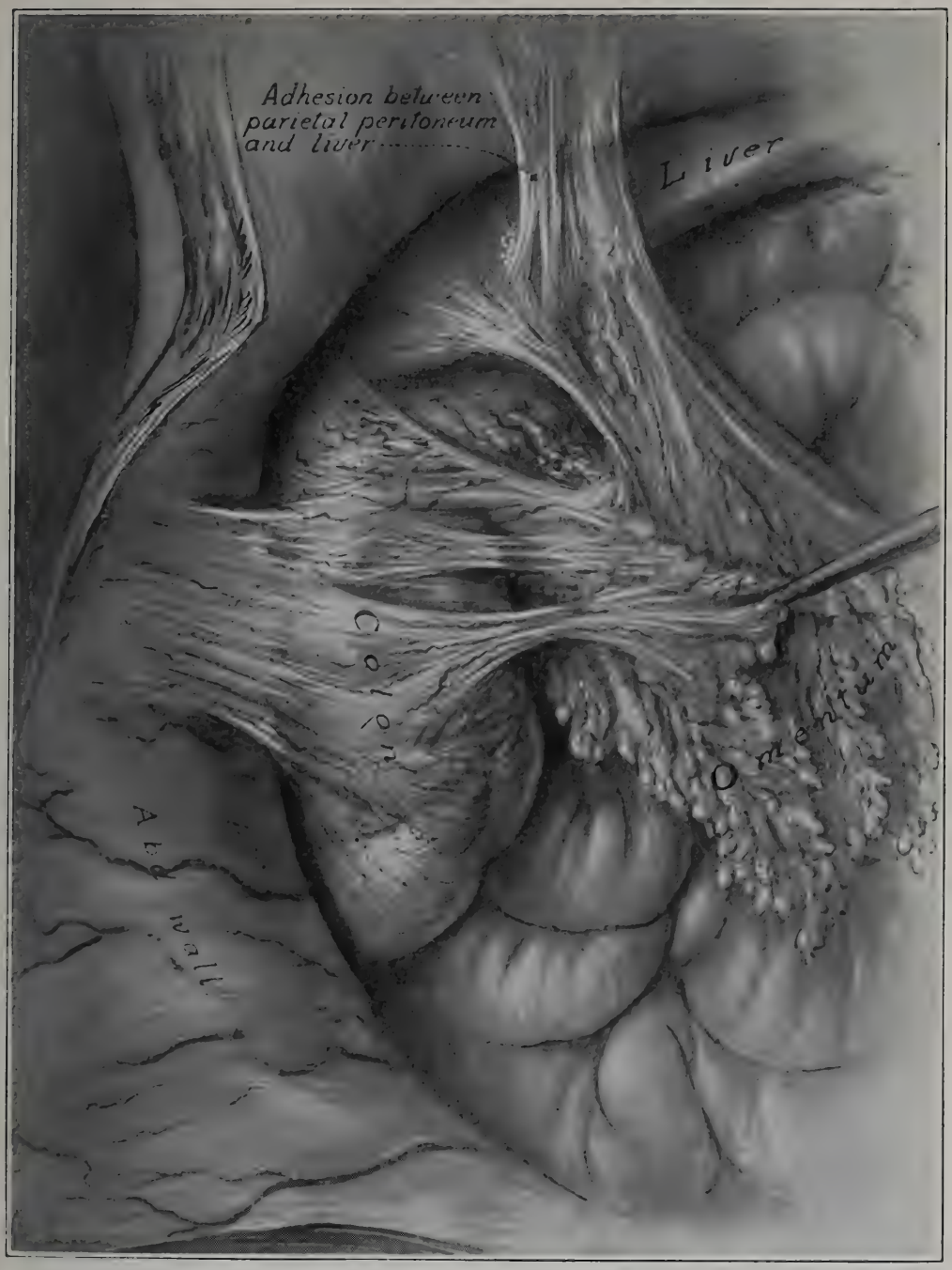

Fig. 5. Residue of adhesions remaining after an attack of appendicitis. The colon is attached to the parietal wall, and the omentum is adherent to the colon, liver, and anterior abdominal wall.

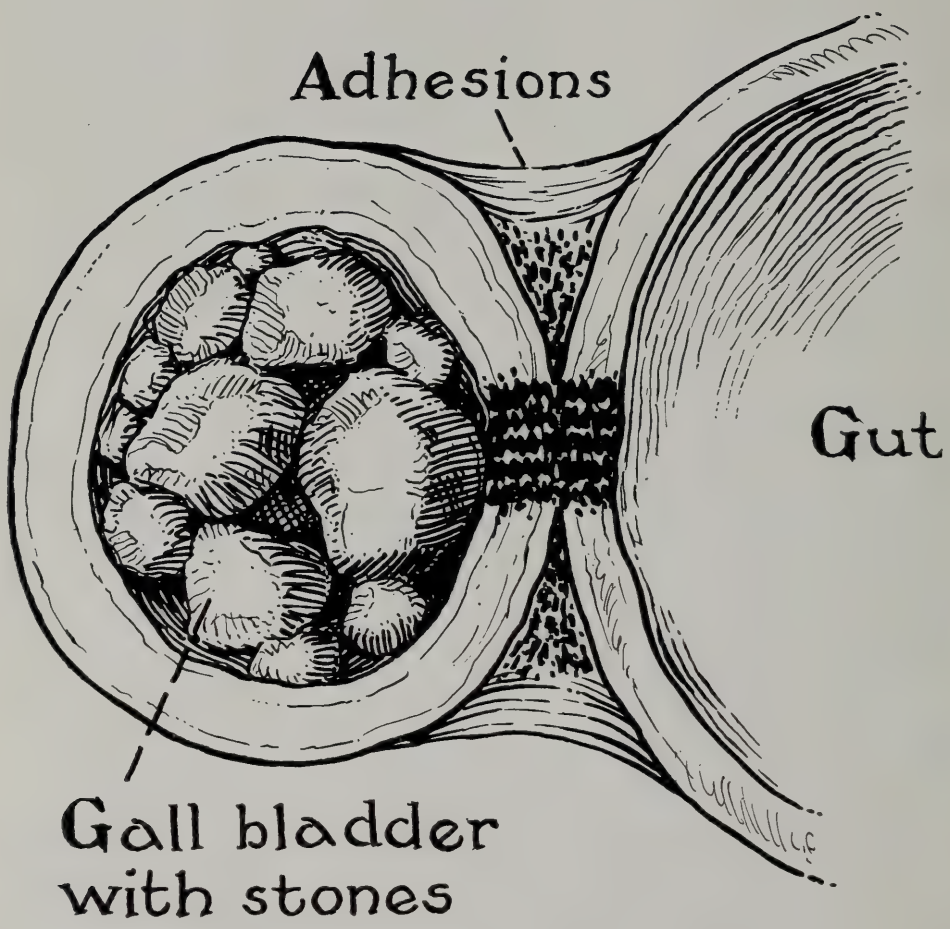

Fig. 6. Schematic drawing showing the relation of temporary adhesions in the gut-perforations. The middle dark zone between the hollow organs represents the portion of the wall undergoing necrosis. The granular zones at the side of it represent temporary adhesions walling in the necrotic area, while the outer striated zones represent fibrillar fibrin, which will form the permanent adhesion.

way, the lesion is permanently patched, and disaster averted. If the reaction is greater, granular fibrin immediately forms over the ulcerous area (Fig. 6), and it is only some distance from the site of greatest irritation that permanent adhesions can form. If the process now stops as an end-result we see a permanent adhesion some distance from the scar of the lesion, while over the lesion itself the temporary adhesions have been absorbed and the peritoneal surface is free from adhesions. By some distance, I mean just that. An impending duodenal perforation may leave its mark between the liver and the diaphragm, between the stomach and the colon, between the great omentum and the colon or the stomach, etc. It is not unusual to find adhesions some distance from an old scar in the region of the outlet of the stomach. For instance, adhesions between the gall-bladder and the colon and a dimpled scar near the pylorus may be all that remains of a process that once saved the patient from an impending perforation.

In order to convince oneself of the correctness of the interpretation of the sequential processes as above indicated, one must observe the various stages of the condition as seen clinically. I once operated on a patient who gave a history of ulcer perforation. After some weeks he recovered, and was fairly free from disturbance until a day before operation, when renewed symptoms developed. At operation young adhesions similar to those illustrated in Fig 7 were found. An old duodenal ulcer was adherent to the gall-bladder and colon, and was thus partially walled off. A secondary perforation had taken place, giving rise to renewed symptoms. The ulcer was resected with as little disturbance of the adhesions as possible.

More striking still are those instances in which an actual escape of gastric contents occurs without the

preliminary formation of adhesions. The extent to which these adhesions may form in such conditions is astonishing. In one autopsy I reviewed there were adhesions between liver and abdominal wall; colon and gall-bladder; omentum, colon, and abdominal wall. (Fig. 7.) A healed ulcer of the pyloric end of the stomach showed a puckered scar of the peritoneum, itself free from adhesions which alone remained to reveal the site of the irritation that had caused the adhesions above mentioned.

The relation of the healed ulcer to the adhesions depicted in Fig. 7 can hardly be doubted. Material escaping from a perforation in the region of the duodenum tends to gravitate downward over the watershed furnished by the colon and omentum. Fluid is early found laterally to the colon and cecum in such cases. The first patient I ever operated on for perforation of a gastric ulcer presented strands of sourkraut distributed from the point of perforation over the colon and laterally to it and over the right half of the great omentum. The patient was a German. The inflammation was confined to the region above indicated and to the subhepatic region. So universal in fact has been the observation of this tendency of the fluid from perforations of these ulcers that pelvic drainage is regularly instituted. Operations on the second or third day sometimes show early adhesions in the region above indicated. True, not all surgeons agree with this interpretation. Pilcher ("A Further Contribution to the Study of Pericolic Membranous Films and Bands," Ann. Surg., 1914, lix, 1) quoting a case in which the adhesions similar to those noted above were encountered, believed the infection began in the region of the appendix and extended upward. This explanation, however, I believe, goes counter to the experience of most surgeons. Certainly so in those

Fig. 7. Adhesions between the omentum and the parietal wall and between the colon and the gall-bladder and liver and parietal wall. A pyloric ulcer which had healed was the cause of the infection.

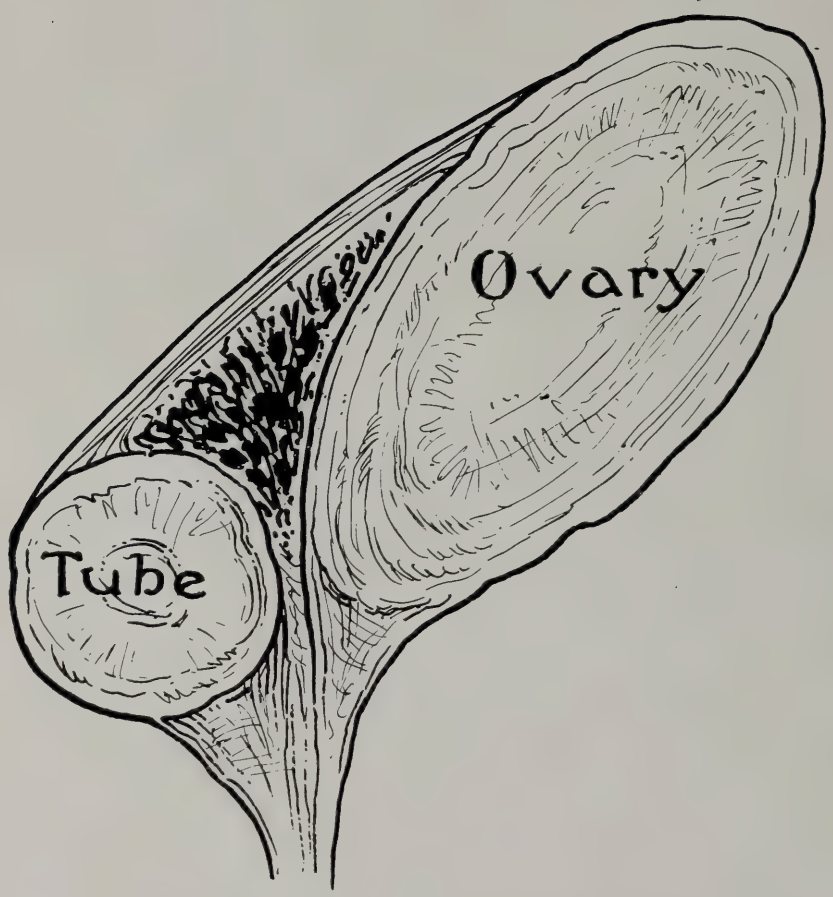

Fig. 8. Schematic drawing of an infected tube and ovary. The granular area between the tube and the ovary represents the temporary adhesion, while the longitudinal lines above it represent the fibrillar fibrin, which forms the permanent adhesion after the granular material beneath has become absorbed.

cases in which there is a healed perforation in the stomach or duodenum, indicating a former source of infection. Similar cases are recorded in the literature. Riedel ("Ueber Peritonitis chronica non tuberculosa und ihre Folgen Verenerung des Darnes und Dislocation der rechten Niere," Arch. f. Klin. Chir., 1898, lvii, 645) records a case in which, following a gastric ulcer, the duodenum, stomach, and great omentum were matted together.

Such adhesions as are above noted can occur only in cases when the infective material escaping from the stomach is of but slight virulence. This must be admitted because the patient recovers spontaneously,—not a very frequent termination, at best. In the more virulent cases, rescued only by operation, the infection may be so virulent that no permanent adhesions result except about the regions where the gauze drain is placed, when such is used.

The field in which these permanent adhesions are of frequent occurrence, and where they may most easily be studied, is the pelvis following gonorrheal infections of the tubes. The gonococcus is a pronounced fibrin-producer, and the permanence of the adhesions is due to the relatively mild pathogenicity of these organisms. An enormous fibrinous exudate, both beneath the peritoneum and on its surface, is produced. That beneath the peritoneum is granular, and later undergoes absorption, and the major portion of that exuded upon the surface of the peritoneum is also of this character. On the surface of this granular exudate a layer of fibrillar fibrin tends to form. This is particularly true in the milder infections or in those of long duration.

It is here that the general plan of pseudoperitoneal formation can best be studied. When an exudate about infected tubes and ovaries occurs it fills in the

chinks between them and any neighboring structure. This is granular fibrin, and receives on its surface a fibrillar layer (Fig. 8), which bridges the gaps between ovaries and tubes with bundles of fibrin. When this process has finally run its course the fibrillar fibrin filling the chinks is absorbed, while the surface layer becomes organized into fibers. There remains only the new membrane extending across the space from the tube to the ovary. (Fig. 9.) These adhesions may be very thin, and sometimes are interrupted,—a condition designated in clinical parlance as "cob-web" adhesions, with which every surgeon's fingers are familiar; or they may form bands or even may form complete membranes, totally encapsulating the ovaries.

Adhesions Due to External Violence.—Adhesions may result from contusion of either the parietal or the visceral peritoneum, or both. The process may be imitated by exposing the transversalis fascia, pinching it and the peritoneum with forceps. Adhesions will form at this point. By opening the abdomen and crushing any internal organ the same result can be produced. The necessary factor is that the trauma must be sufficient to produce the exudate, yet not great enough to start processes which will destroy the coagulability of the exudate.

Blows by blunt objects may injure a hollow organ to such a degree that necrosis of the traumatised area occurs. If the process is slow adhesions may cover it in part. An instance of this may be cited as follows:

A man was kicked in the abdomen by a horse. After three weeks a fecal phlegmon formed, which, when drained, left a fistula extending to the gut. A later operation showed that a fibrous tube formed by permanent adhesions led from the gut to the exterior of the body. In this case the center of the lesion was

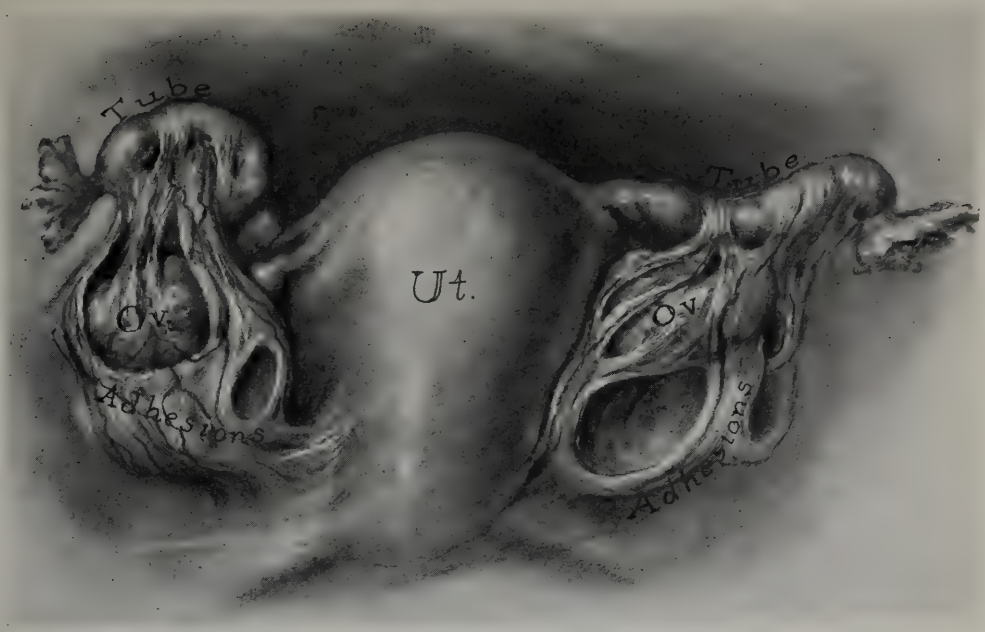

Fig. 9. Permanent adhesion-bands about the tubes and ovaries after a gonorrheal salpingitis.

Fig. 10. Gut-wall held close to the foreign body by adhesions ten days old.

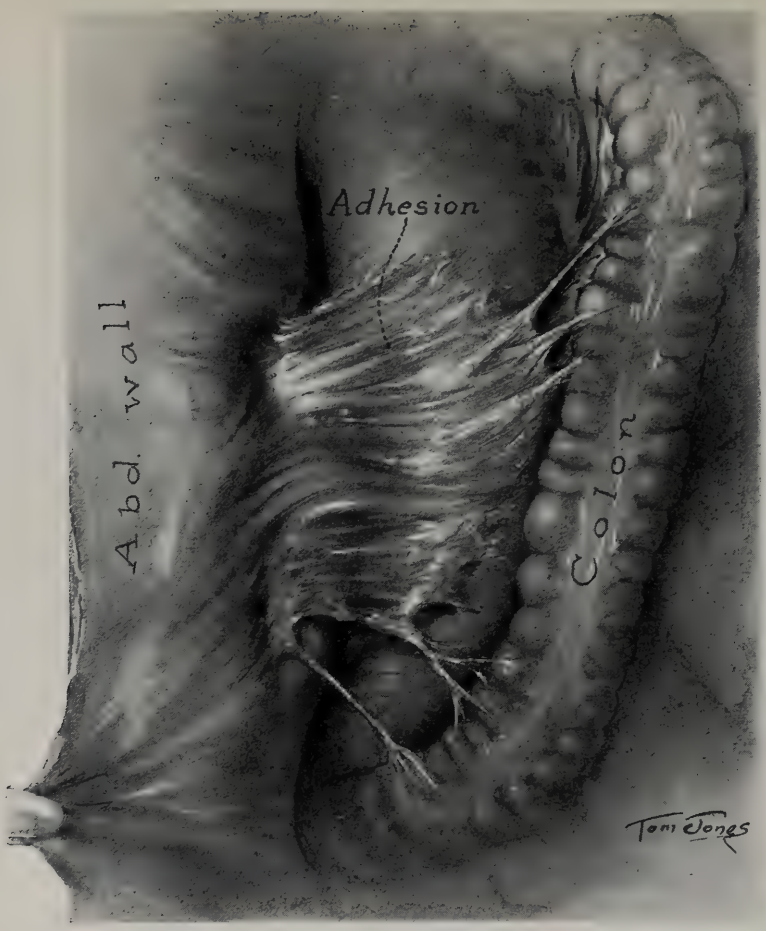

Fig. 11. Same sort of adhesion as in Fig. 10, showing beginning attenuation due to traction.

Fig. 12. Still older adhesion showing extreme attenuation.

injured to such a degree that permanent adhesions could not form, while adhesions did form at the periphery. This process may be reversed when an infection becomes walled off in the peritoneal cavity. Here the infective mass gradually destroys the wall of an adjoining hollow viscus until perforation is complete and the abscess empties itself into the lumen of the gut. If the process is of low virulence, and encapsulating adhesions become fibrous, a permanent adhesion results, perchance, some distance from the original injury.

Another case may be cited to exemplify the greater degree of injury. A carpenter fell from a scaffolding striking his abdomen on a blunt object. After some hours he returned to work. On the fifth day he suddenly began to suffer from a generalized peritonitis. At operation an opening in the gut the size of a dime was found, due to the necrotic separation of the contused area. Here the area was so badly injured that even a temporary adhesion did not form, and when the injured area separated by necrosis general infection of the peritoneum followed.

Adhesions Due to Injuries During Operation.—The most potent source of permanent adhesions is the manipulations of the surgeon. Wherever there is injury to the peritoneum an exudate capable of forming an adhesion with a neighboring surface, is produced. The most prolific source of post-operative adhesions is the incision in the peritoneum. The effect of an incision into the peritoneum has been observed in the human subject with great scientific exactness. When a patient, the subject of a previous operation, is laparotomized a second time it is very common to find the omentum adherent to the site of the former incision through the peritoneum. In the days of the through-and-through suture, which allowed the edges

of the peritoneum to retract and thus to become exposed to the abdominal contents, adhesions were almost universal. As our technic improved, the effect of more careful closure of the peritoneum became manifest. It has been found that, if the edges are carefully everted into the wound, allowing only a suture line to present toward the peritoneal cavity, adhesions are prevented with a considerable degree of certainty. These observations are sufficient to demonstrate the importance of the cut edge of the peritoneum in inviting adhesions. Other injuries, such as perforations by the teeth of forceps, or marked blunt trauma inflicted by retraction, may act in like manner. Pedicles remaining after the ligation of peritoneum-covered organs, such as the appendix or a portion of the omentum, leave exposed surfaces which are almost certain to result in adhesions. Any foreign body allowed to remain in the peritoneal cavity results in adhesions.

While such obviously gross lesions result in adhesions almost with certainty, much speculation has been indulged in as to the influence of many minor factors. The problem of interest here is the determination of the degree of injury incident to operations which will initiate the process of adhesion-formation. It may be set down as a fundamental law that the loss of endothelial surface will produce sufficient exudate to secure adhesions. The difficulty lies in determining when this degree of injury has been inflicted. Surgeons' estimates of it have varied greatly.

Among the lesser degrees of injury that may produce adhesions may be mentioned mere puncture by the suture, as in inverting an edge of peritoneum. This likelihood is increased if the suture material has been sterilized by a chemical irritant to the peritoneum, notably iodine. The constriction of a bit of tissue by

a ligature causing necrosis of the part so constricted, produces adhesions. Blood-clots beneath the peritoneum act in the same way. Corbett ("Peritoneal Adhesions," Surg. Gynec., & Obst., 1917, xxv, 166) demonstrated this simply by puncturing a mesenteric vein with a needle, allowing a small amount of blood to escape beneath the peritoneum. The effect of blood in the free peritoneal cavity on the formation of adhesions has been variously estimated. Fluid blood, generally speaking, is absorbed without any irritation. Clotted blood when lying on uninjured peritoneum likewise is absorbed without injury. When lying in the region of injured tissue the presence of clots invites adhesions. The reason for this is obvious. When lying on uninjured peritoneum none of the factors which incite to fibrous-tissue formation enters the field, while when there is injury to the surrounding tissue these processes at once become active.

It is safe to say that any process which is capable of destroying the endothelial layer is capable of forming adhesions. It is difficult to say whether or not as the result of any manipulation cells have been completely removed, or if the basement membrane has been injured. Oblinski ("Ueber den Bauchschnitt inneres Darmverschluss," Arch. f. klin. Chir., 1889, xxxviii, 249) believed that injury from the surgeon's fingers during manipulations of the gut could cause such a degree of injury. Vogel (l. c.), on the contrary, found that very vigorous rubbing with the gauze-armed finger failed to cause adhesions.

The amount of violence necessary to produce a degree of abrasion sufficient to cause adhesion has been greatly underestimated. Actual abrasion of endothelium requires considerable violence. If one wants to secure isolated endothelial cells for study it requires considerable effort to loosen them with a dis-

secting needle. The peritoneal surface is physiologically more delicate than it is anatomically. For instance, a surface may be rubbed with considerable violence with a gauze-armed finger without destroying the anatomical integrity of the surface; the physiological equilibrium, however, will be upset. The vessels dilate and the exudate begins to show between the cells, as may be shown by staining such surface with silver. Such reaction is usually not followed by adhesions, however, since the reaction ceases with the removal of the irritant. The omentum is vastly more sensitive to mechanical insults than other endothelial covered surfaces since the perivascular tissue is more sparse, and the capacity to return to normal is much lessened in consequence.

On the other hand, if the entire basement membrane, together with the connective tissue lying beneath, is removed, much of the adhesion-forming power is destroyed. The underlying muscle possesses the power of forming adhesions very imperfectly, as we well know from experience in making anastomosis of the esophagus and extraperitoneal portion of the large gut. This may be easily demonstrated by dissecting off the parietal peritoneum or by destroying it with a cautery. This fact is made use of in a practical way by cauterizing, with the actual cautery, surfaces which could not be covered with peritoneum.

Simple pressure without puncture may produce adhesions, as can be demonstrated by retaining two peritoneal surfaces in close apposition by means of lead plates. The same point has frequently been demonstrated by the use of the Murphy button. Fecal impaction in rare instances may act in the same way. The pressure need only be strong enough to shut off the circulation. Death of tissue then occurs, and the dy-

ing tissue produces the irritation which sets forth the fibrin-forming processes.

A great variety of chemicals are capable of injuring the endothelium to a degree sufficient to cause adhesions. All of the antiseptics cause it, iodine being perhaps the most active of all. Uyeno ("Ueber dem Schicksal der peritonealen Adhäsionen und die Einflussung durch mechanische Massnahmen im Tierexperiment," Beitr. z. klin. Chir., 1909, lxv, 277) found that even weak iodine solutions caused adhesions. The effusion from iodized catgut when used in the peritoneum may excite to extensive adhesion-formation. Corrosive chemicals are less likely to cause adhesions, because the basement membrane is destroyed. Strong solutions of iodine may act in this way. Such solutions, instead of exciting the peritoneum to fibrin-formation, precipitate the exudate into a granular débris incapable of fibrilization.

Prone as is the peritoneum to form adhesions, it is doubtful if mere exposure to air can excite adhesions. My window experiments (l. c.) make me believe it does not.—Walthard, ("Zur Aetiologie peritonealer Adhäsionen nach Laparotomien und deren Verhütung" Cor.-Bl. f. schweiz. Aerzte, 1893, xii, 513), on the other hand, accused the contact of air with the most dire effects. According to him, contact with air produced adhesions during operation unless the surfaces were protected by moist packs. He believed such contact invited infection also. Uhlmann ("Ueber das Auftreten peritonealer Adhäsionen nach Laparotomien, mit besonderer Berücksichtigung des Verhältniss zwischen trochener und feuchter Asepsis," Arch. f. Gynäk., 1897, liv, 384) contradicts these statements.

There is individual variation in the capacity to form adhesions. Constitutional diseases, particularly those of the blood, reduce the capacity for adhesion-forma-

tion. This, in a measure, parallels the effect on the coagulation-time of the blood. This is quite true for the initial processes, and less so for the changes which occur in the later stages of the healing processes. The factors here involved are too intricate to permit of solution in our present state of knowledge of chemical processes in diseases of the blood.

An excessive individual predisposition to the production of adhesions is sometimes noted. The following condition is sometimes encountered: An individual who has been operated on develops adhesions and is re-operated on, and more adhesions form. This sequence lasts as long as the patient does, or the hopeful persistence of the surgeon endures. Often the disposition to unusual production of adhesions is stimulated by the pernicious habit of "breaking up" adhesions already present. The frayed edges are produced in this way, which furnish the best possible stimulus to the further production of adhesions. By the time this process has been repeated a number of times, an astonishing number of adhesions may be present. In some instances, exudates are very extensive, and coagulation and organization seem to take place throughout the mass. In this way veritable keloids are produced.

Results of Permanent Adhesions.—The purpose of permanent adhesions is the repair of solution of continuity. Intestinal repairs and anastomoses are made secure, and incisions through the peritoneum are restored to their former state. Without this faculty abdominal surgery would be impossible.

The misdirected activity of the process may cause trouble, but it is undeserved reputation of adhesions for mischief, due to the slanderous conversation of surgeons, rather than to the real mischief they do, which has brought them into ill repute. If the sur-

geon would view them as scars with the same open mind that he views scars elsewhere a better understanding would soon ensue.

The disturbance of function of a hollow viscus or pain are the usual symptoms produced by the unnatural fixation. Each of these is a surgical rarity. In order that an adhesion shall cause pain it must limit the mobility of a movable organ. Pain produced by adventitious bands is unusual unless disturbance of function result. Usually, such conditions exist only in the mind of the surgeon, and in that of the patient due to the tutilage of the surgeon. Severance of such adhesions does not relieve the difficulty. Explanation of failure to relieve by operation must be sought in a wrong diagnosis, and not in the occurrence of post-operative adhesions. This is not true in all cases, to be sure, but, if this dictum were followed, the vast proportion of relaparotomies might be avoided.

In order that adhesions shall disturb the function of a hollow viscus, the lumen of it must be narrowed to an extent incompatible with the proper performance of its function. Such a state is manifested by hypertrophy proximal to the site of constriction. If there is no such evidence of disturbance of function the diagnosis must be questioned. The mere fact that a woman is constipated and has an adhesion does not associate constipation and adhesions in a causative relation. Perhaps she is suffering from splanchnic inhibition because her husband has died, or ought to die. Loose interpretation of the rules of logic has so vitiated the literature that few valuable data can be collated.

Adventitious bands, the relics of an old adhesion, are the most frequent cause of real mischief. By suddenly looping over such a band, an acute obstruction may be produced.

Adhesions of a loop of gut to an inflamed focus may

occur at the height of the process. The occlusion may be enhanced by the edema from the inflammation. These may be spontaneously freed when the reaction is complete.

The literature is replete with evidence that complications may follow an adhesion which is either the result of external injury or of operative procedures. A number of instances may be cited. Fogel ("Klinische und Experimentelle Beiträge zur Frage der peritonealen Adhäsionen nach Laparotomien," Deutsche Ztschr. f. Chir., 1902, lxiii, 396) reports a number of striking instances. Riedel ("Ueber Adhäsionen in der Bauchhöhle," Arch. f. klin. Chir., 1894, xlvii, 153) records a case in which, following an injury produced by a blunt object striking the abdomen, the abdominal wall, the gall-bladder, and the omentum were matted together.

Lucas-Championiere (Bull. et mém. Soc. de chir. de Paris, xviii, 102) reports a case in which adhesions leading to the ileum followed peritonitis after an ovariotomy, one following the drainage of a local abscess. Dalem ("Laparatomie bei Ileum," Diss. Halle, 1883) reports two cases from Olshausen's clinic in which ileus from adhesions following the treatment of stumps of tumors with iodoform, took place. Riedel ("Die Entfernung von Narbensträngen und Verwachsungen entstanden durch entzündliche Processe in der Gallenblase und in den inneren weiblichen Genetalien," Cor.-Bl. d. Allg. Aerzte Vereins von Thüringer, 1890, xix, 425).

The End-Results of Adhesions.—An adhesion represents a scar and, as such, is prone to undergo the changes such tissue usually undergoes. In this experimental evidence and clinical experience are in accord. In order that any scar may contract, uninterrupted healing must occur. Usually adhesions are formed in

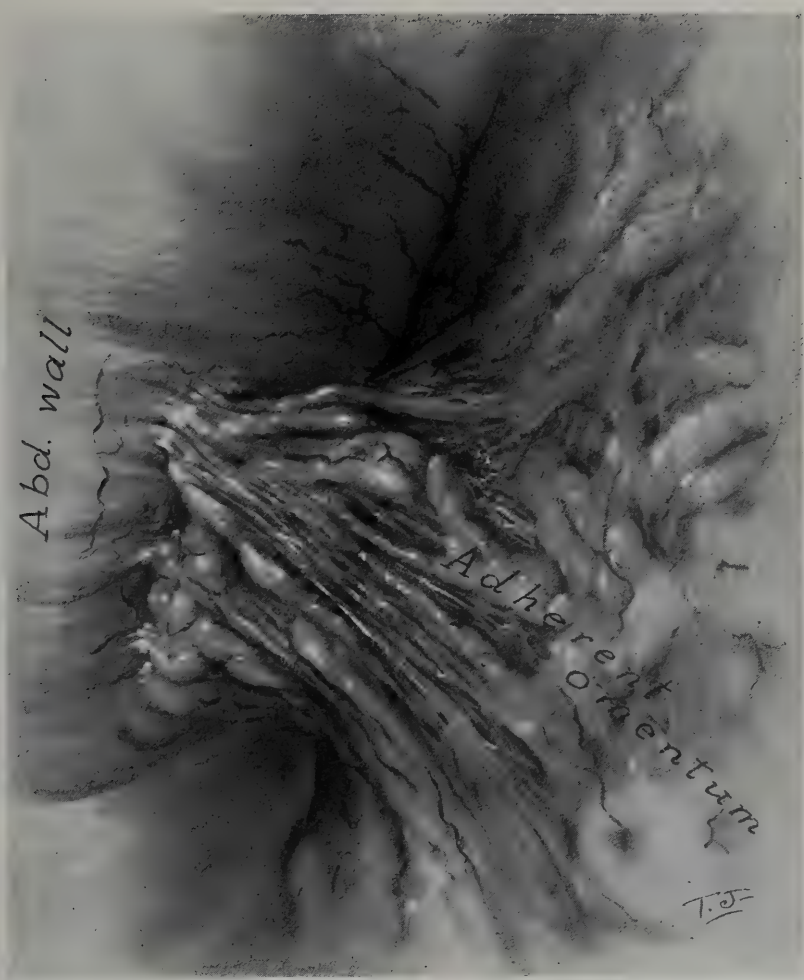

Fig. 13. Mass adhesion of the omentum to the abdominal incision. Duration, two weeks.

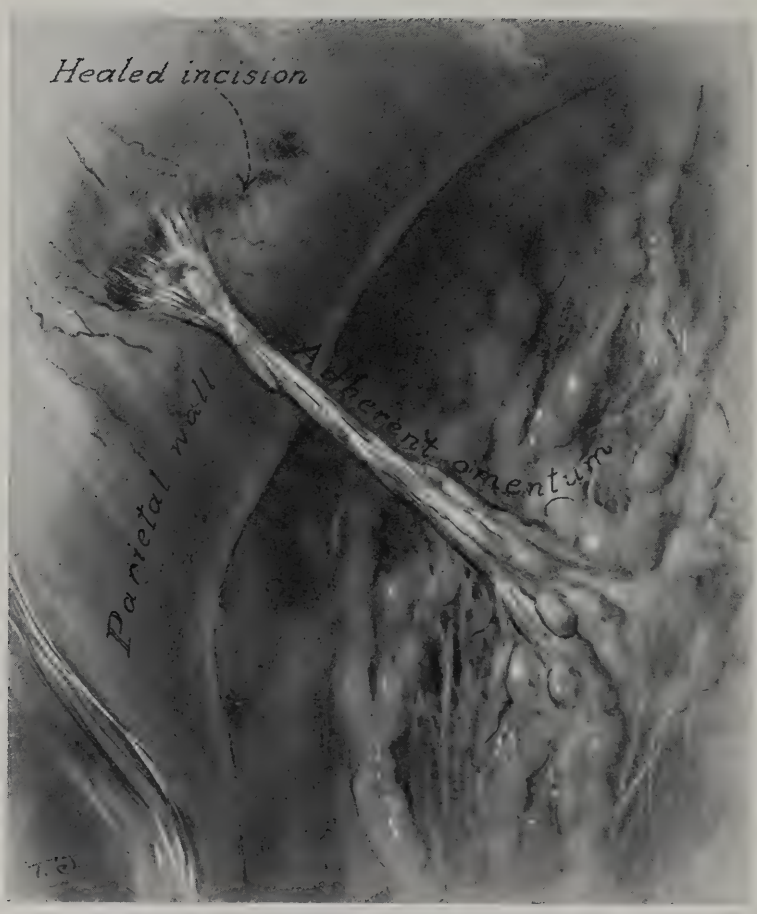

Fig. 14. The same adhesion as in Fig. 13 after four weeks. These stages were noted through re-laparotomies.

the region of disease processes, and consequently healing is not ideal and stretching is the rule. Most surgeons have had a chance to observe a skin scar contract while the fascial scar beneath stretched because of some irritation during the course of healing. As a rule, during the uninterrupted healing the scar tends to contract, in general, an amount equal to one-third of its length. Traction on a young scar may cause it to elongate. This point can be tested by re-laparotomizing animals on which experimental adhesions have formed; and calculations in re-laparotomized human subjects will bear this out. When a foreign body placed in the peritoneal cavity first becomes imbedded in adhesions, the organ lying over it is in actual contact. (Fig. 10). As the process becomes older, the adhesions elongate. As time goes on, these become much attenuated. (Fig. 11.) After the lapse of a considerable period (a month or more) the adhesions may be thin and web-like. (Fig. 12.) Very likely they may separate entirely. This is more certainly true if there is any disturbance in the process of wound-healing. This tendency to stretch is most marked in the case of the great omentum. Figs. 13 and 14 show different periods of the same adhesion.

While adhesion-formation can be followed accurately and results predicted in animal experimentation, speculation must always enter in the human subject. Attending the adhesion-formation during diseased processes there is always some disturbance to the ideal condition for fibrous-tissue formation. The reaction caused by the disease influences the fibrin-formation. The process is retarded. Often many weeks are required for the process of change from fibrin to fibrous tissue to occur. Usually there are intense cellular infiltration and an extensive serous exudate.

Adhesions formed under such conditions, like any

scar formed in an infected environment, are prone to stretch. In any human subject in the drainage of abscesses, intestinal coils may be observed to be held in contact by adhesions. A later operation may show only an attentuated band holding these coils together. I have noted this most frequently in conditions which resulted in fecal fistulæ requiring a secondary operation to close.

It will be readily recognized that in this, these adhesions behave quite like scars formed in an infected abdominal incision. Here, it is well known, other conditions aside from frank infections may cause a corresponding disposition to stretch. Injury to a parenchymatous organ, including muscle, may produce unfavorable conditions in healing tissue, leading to a disposition to stretch.

When an infective process is continuous, masses of scar tissue may be produced. This is sometimes seen in diverticulitis, causing an extensive cicatricial thickening of the mesentery. It is prone to occur also when there is a retroperitoneal infection. I have noted it most frequently in the parietal peritoneum over a kidney when an infected perinephritis has long been drained. Here the scar in the peritoneum over the kidney extending over the duodenum may be represented by a heavy cicatricial band. The same thing may occur within the broad ligament in parametritis, producing retraction of the uterus. The peritoneum may come in such cases to resemble the pleura in suppurative pleurisy.

That an adhesion may become stronger because of continuous traction, as assumed by Lane, is contrary to the known behavior of scars. Since no evidence has been produced to substantiate such a theory it may be regarded as a peculiar "crystallization of forces" not generally applicable.

Temporary Adhesions.—In the preceding section permanent adhesions, having for their purpose the repair of solutions of continuity, were discussed. In this section in contrast with these the other type, the temporary, having for their purpose the mechanical limitation of infective processes, will receive consideration. The designation chosen is warranted because their duration is co-extensive with the duration of the infection. This statement is true in general terms only, for, when an infective process is of long duration, the adhesions induced by it may become permanent.

The mechanical limitation of infections is secured by the building of a barrier about the focus of irritation by the union of organs lying near it. This is accomplished by the formation of an exudate on the peritoneal surface of the organs which harbor the focus of infection. This exudate, coming in contact with other peritoneal surfaces, excites a similar exudate. These exudates become confluent, and, together with the peritoneal surfaces which produce them, form a barrier to the advancing infection. The purpose of these barrier-walls is so to limit the area of infection that the individual may not be overwhelmed by the absorption of toxic products. The actual inhibition and annihilation of the noxious agents is the task of other agents. It is worthy of note in this place that it is through the barrier-walls that these agents reach the site of infection, so that their existence is of more than mechanical importance, though it is this phase only that interests us here.

If competent, the infected area becomes quarantined against the surrounding peritoneal cavity by the barrier-wall, and an encapsulated abscess, in clinical parlance, results. If not wholly competent, the infection spreads in one direction while barred in others. On

the other hand, infection, once localized because of increased tension within the abscess, may break the barrier and spread again. The advancing border may be secondarily limited by new adhesions. This is exemplified frequently in appendiceal abscesses, where a barrier is formed above and medially, but the infection spreads into the pelvis only, again to be limited by new adhesions at the advancing border. Because of this tendency to advance, every possible degree of inflammation, from the completely localized and the unopposed diffuse, may be encountered.

The pathogenesis of the temporary adhesions is altogether analogous to what has been discussed as healing by second intention. The exudate which forms in response to the stimulus exerted by the invading infection, undergoes coagulation. This coagulation, because of the toxic influence exercised by the infective agent, does not precipitate a fibrillar fibrin, as it does when a permanent adhesion is the result, but, instead, a trabecular and a granular sort is thrown down. The character of this fibrin is determined by the intensity of the infection, and, conversely, the firmness of the barrier-wall is determined by the character of the fibrin. In intense infections in which the formation of any sort of fibrin is largely interfered with, the adhesions may be absent, or are so feeble that they are powerless to limit the spread of the exudate.

The groundwork of these exudates is made up of a meshwork of fibrin fibres arranged much like the trabeculæ of reticular tissue. (Fig. 15.) They react specifically with the Mallory and van Gieson stains, but stain imperfectly though perceptibly with Weigert's stain. The less intense the infection, the more complete is this meshwork, and the more typically it stains. These meshes are filled with a granular exudate of varying density. In some instances, however,

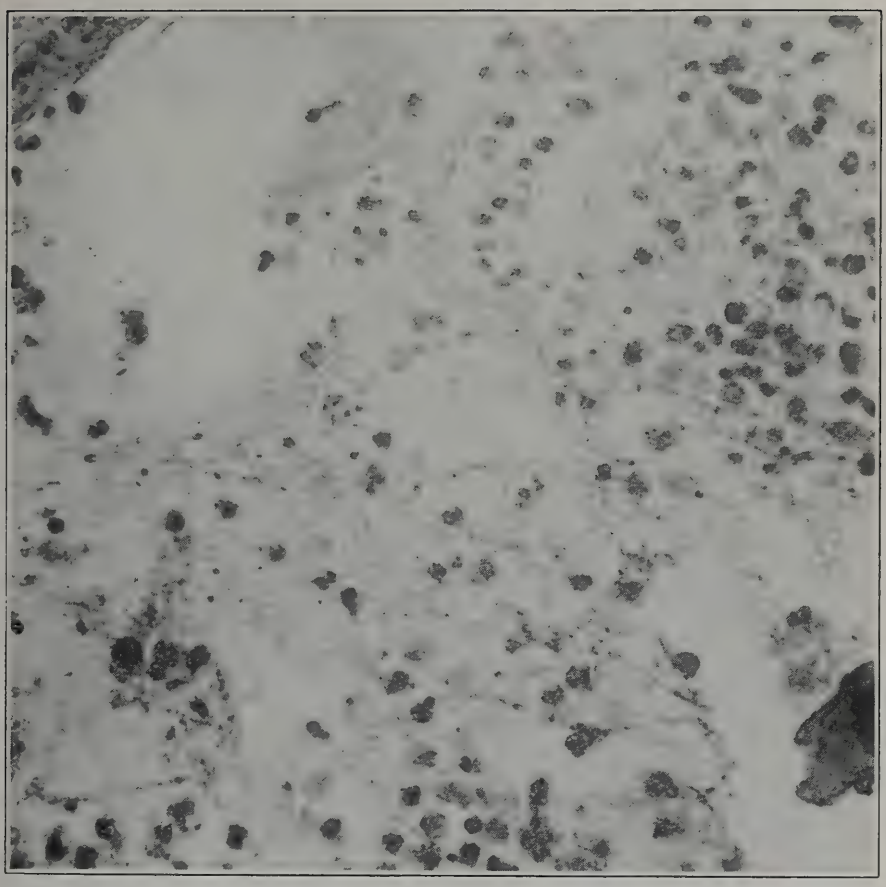

Fig. 15. A section of the fibrinous exudate in acute appendicitis. The fibrin bundles assume a trabecular arrangement.

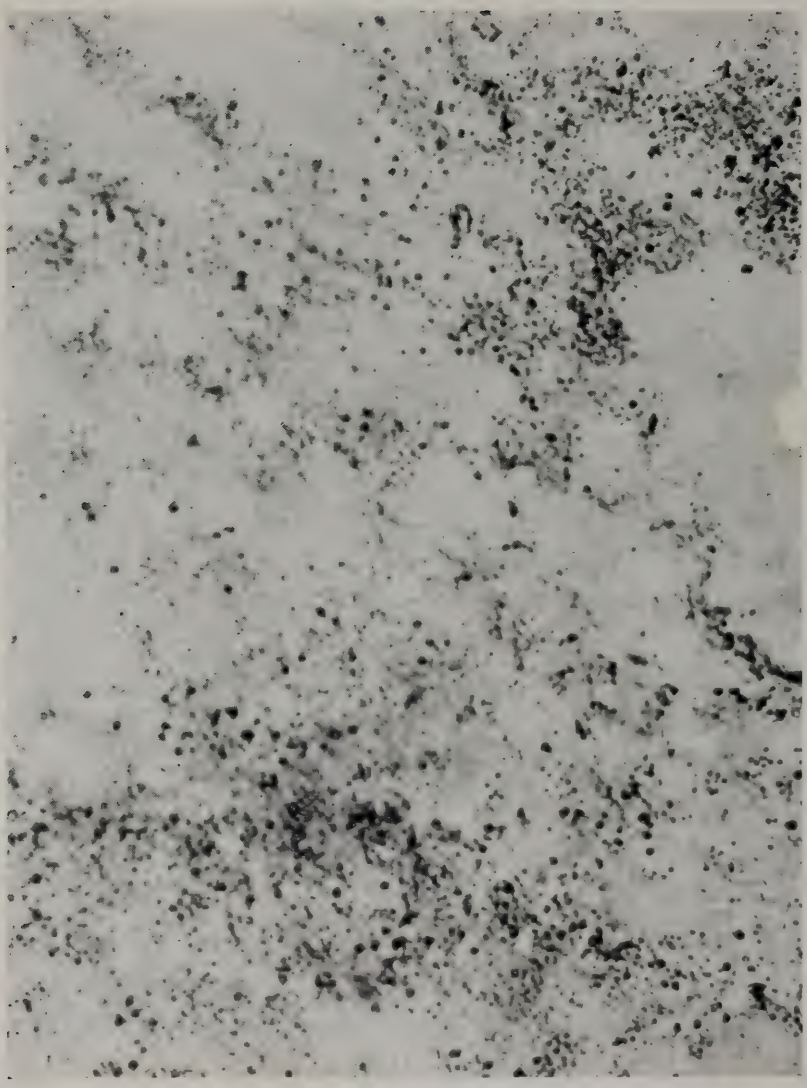

Fig. 16. Section of an exudate in a more intense infection than that shown in Fig. 15. No definite structures can be made out.

the meshes are filled with an exudate, for the most part amorphous, containing few granules. The granules of this exudate may be regarded as fibrin, since it takes the fibrin stain, though in the more intense infections the histochemic response to specific fibrin stains may be incomplete and imperfect, and in the extremely intense infections may be lacking entirely, and the material present may be represented by a débris irresponsive to any stain. (Fig. 16.) The essential fibrin character of this material must then be hypothecated because of its physical characteristics and because every degree of tinctorial variation is encountered, varying from the typical to the entirely negative. This is true, not only in material obtained from successive patients representing variable degrees of virulence of infection, but even in the same patient, in different regions and in varying stages of the disease, the various types may be recognized.

Aside from this trabecular and granular material which forms the mechanical factor of the limitation of the infection, there are many cells present, chiefly polynuclear leucocytes, in varying degrees of integrity. In moderate infections they are abundant, and their nuclei and protoplasm are well preserved for the most part. When the infection is more intense the nuclei are paler, the protoplasm is part destroyed, and, in general, the cells are less abundant. With more intense infections the cells may be partly disintegrated, or even wholly so, and the badly staining nuclei lie bare of any protoplasm. In the most intense infections there may be nearly an entire absence of cellular elements, and the exudate is a formless granular mass devoid of any elements and wholly refusing any stain, so that it is impossible to tell whether the granules represent fibrin or disintegrated cells.

This varying picture may be further complicated by

a change in virulence of infection. An infection, moderate in degree at the onset, being represented by an abundant polynuclear exudate, may cause, when the infection becomes more intense, these cells in some instances to degenerate. In such instances the microscopic field shows a mottling due to the intermingling of the degenerated and the active field.

With the subsidence of the virulence of the infection the contrary changes in cellular inhabitants takes place. Among the degenerated cells new well-staining ones appear. After the infection is definitely regressive, as after the emptying of an abscess, restorative processes are particularly well marked. This finds expression in the appearance of mononuclear leucocytes. It is possible by observing these changes to determine whether the disease was progressive or subsiding. When patches of viable and degenerated leucocytes co-exist an advancing disease may be assumed, while, if degenerating leucocytes are intermingled with mononuclear cells, the disease may be assumed to be regressive.

Upon the appearance of the mononuclears, the exudate begins to lessen. The granules already noted are englobed by these large cells, and gradually disappear. Whether convoyed out of the region of infection as solid particles or liquefied and absorbed as a fluid substance, cannot be stated. A search in the neighboring lymph-glands for the presence of particle-bearing cells has not given trustworthy positive evidence. Some of these cells remain in the infected tissue, become smaller, and their nuclei take the stain more intensely. As this process proceeds, the granular débris lessens, and the adherent tissues loosen and finally become free.

Within the meshes of the surrounding tissues these large cells may be associated with an increase in the

fibrous tissue. Here one may follow the typical process of wound-healing and fibrous-tissue formation as described by the older pathologists as standard.

When there is great delay in resolution of the infected area, as when an abscess fails to be emptied, either by the energies of the surgeon or by the burrowing of the process, a long-continued absorptive activity of the surrounding tissues is developed. At some distance from the primary site of infection the secondary formation of fibrillar fibrin and the subsequent development of fibrous tissue occur, and permanent union between the adjacent organs takes place. By familiarizing himself with the cellular changes above detailed it is possible for the surgeon, in the course of an operation, to determine whether a given adhesion will loosen of its own accord when the period of its usefulness shall have passed, or whether a permanent union has been formed.

The foregoing presents in a brief way the cellular factors involved in the formation of temporary adhesions without entering into details about which there has been so much controversy. The cellular phase is more fully discussed in the section on wound-healing, and in that on inflammation.

At this time we are concerned with only those inhibiting factors which have to do with the limitation of acute processes. These factors can best be understood by following the stages in a specific region. The principle in all is the same. The appendix may be selected because of the frequency of the opportunity for observing conditions in this region.

When the appendix becomes inflamed a varying degree of subserous exudate forms. The greater the exudate the more likely is the process to become walled off. Simultaneous with this exudate in the wall of the appendix the meso-appendix also becomes infiltrated

increasing its thickness sometimes many times. Not infrequently the third of the circumference of the appendix becomes surrounded by the swollen mesentery. (Fig. 17, No. 1.)

The irritation within the mesentery becomes transmitted to neighboring structures. The head of the cecum and terminal ileum become thickened, thus aiding in the creation of a barrier. Gut loops, too, which chance to be in this neighborhood suffer augmentation of their walls, and add their bulk to the task of the creation of a barrier. The posterior parietal peritoneum becomes infiltrated and adapts itself to the inflamed organ. This is sometimes so marked that a considerable perforation of the circumference of the inflamed organ is surrounded.

Aside from the increase in size of the surrounding organs, the most potent factor in the creation of a barrier is the increasing resistance to pressure these infiltrated walls present. The fingers of the surgeon perceive the extent and character of the wall by the density of the tissue. The appendix may feel like a rigid cord, and the gut wall becomes hard and leathery.

The chief organ engaged in the walling-off process is the omentum. It appears at the scene of trouble with a much thickened border. It attaches itself to the inflamed organ, and to the surrounding organs which have responded to the inflammation. (Fig. 17, No. 2.) In this way not infrequently the infected area is covered as with a lid by the thickened omentum. (Fig. 17, No. 3.) Its heavy bulk adds very materially to the blocking-off process. Like the other organs, it becomes very dense to the touch, thus aiding materially in securing an effective dam against the spread of the infection.

To these mechanical factors due to the increase in bulk of the surrounding structures, is added the exu-

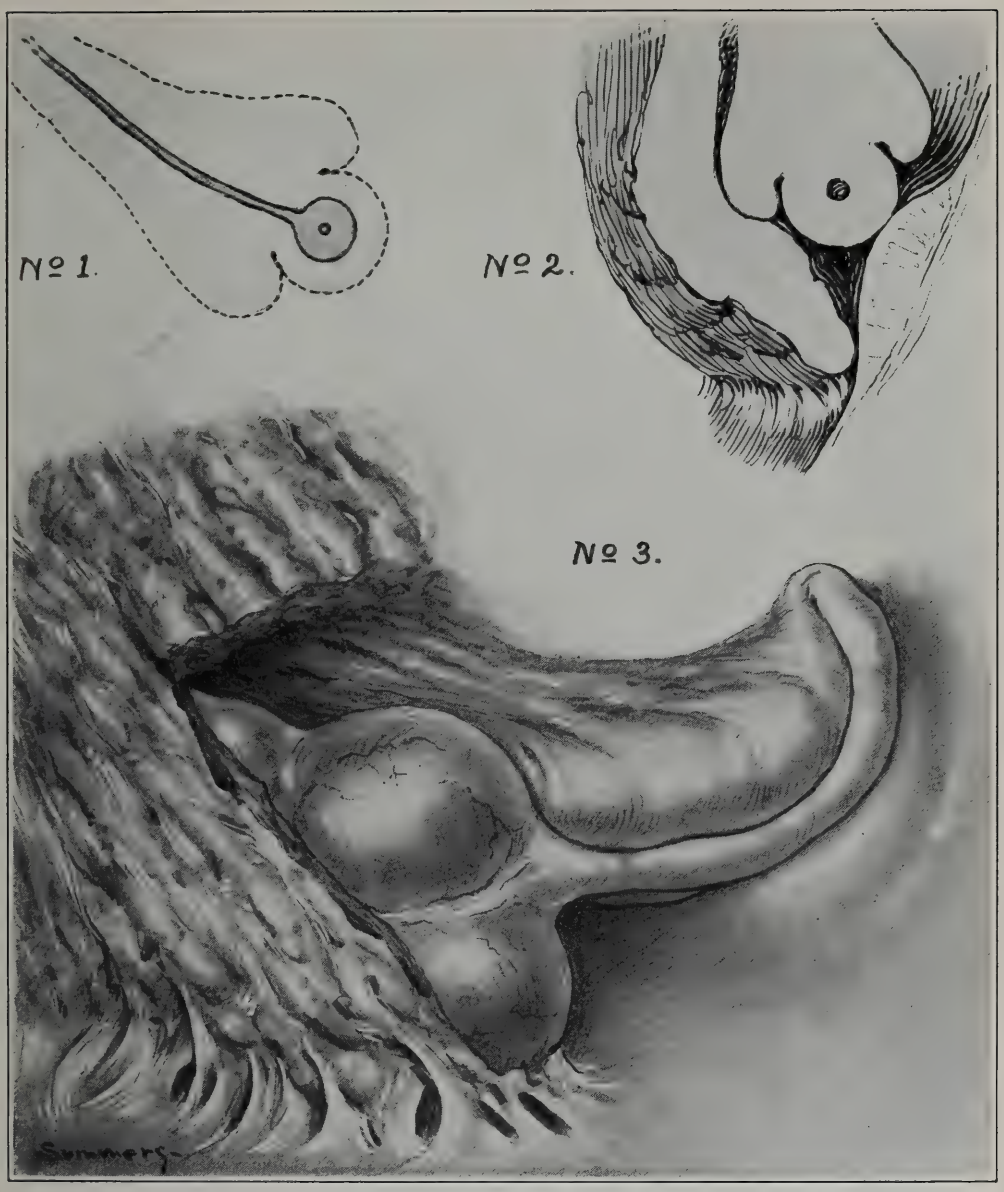

Fig. 17. Diagrammatic drawings of an encapsulated appendix in the height of a moderate infection. No. 1, the appendix is partly surrounded by the edematous meson. No. 2, the omentum is attached over the appendix still further walling it in. No. 3, a part of the omentum has been removed to show the lid-like action of the protecting omentum.

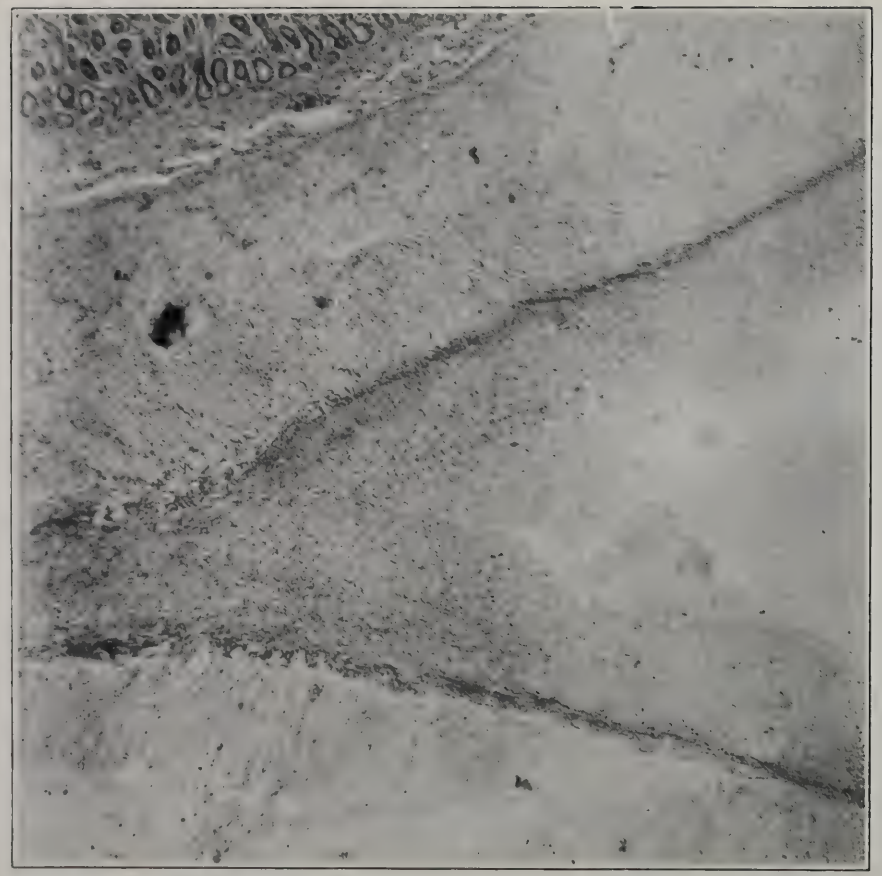

Fig. 18. The angles between the walls of two apposing guts is shown filled with granular fibrin which holds them in temporary apposition.

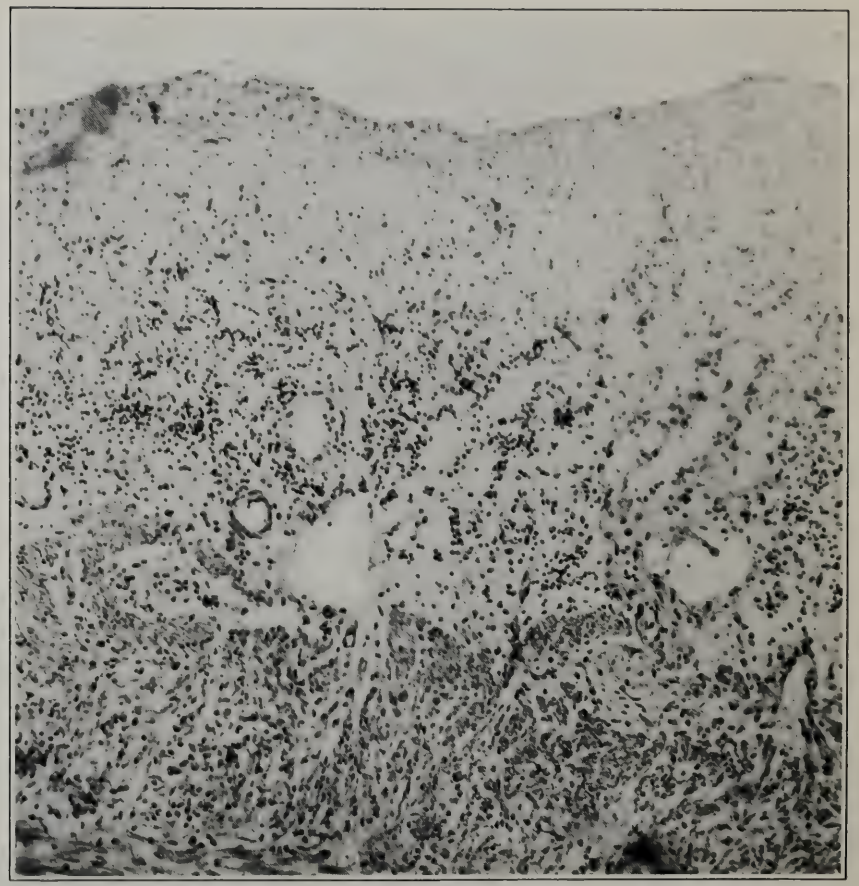

Fig. 19. Subperitoneal exudate in acute peritonitis. The thick layer of edematous subperitoneal tissue is seen above the muscle layer at the bottom of the cut.

date which occurs between these organs. (Fig. 18.) This exudate, becoming precipitated between the chinks and crevices of the surrounding structures, completes the wall, much as cement acts when cast between crushed rock in concrete structure. Because of the thickening of the walls and mesenteries a very small amount of exudate is sufficient to fill the chinks remaining between them and to produce their cohesion.

It is striking to note that the exudate within the walls of an organ undergoes the same changes as take place in the exudate on the surface of the organ. (Fig. 19.) The granular or mesh-like arrangement of the fibrin already discussed, and the character of the cells, are the same. The only difference is one of accident of topography. This is particularly true of the great omentum, but strikingly pronounced in any subserous tissue.

The mass formed by the thickened organs and the exudate between them may be a considerable one. One the size of the fist may be observed in the region of the appendix, and the entire pelvis may be filled with a hard, indurated mass in pronounced cases of salpingitis. In so extensive an area the actual amount of exudate or pus present may be very small, the great mass being formed by exudate within tubes, omentum, and small intestines.

It should be clearly understood that these exudative masses are in the interest of the patient, and, generally speaking, are evidence that the protective factors are in the ascendency. What happens subsequently depends on the activity of the infected area. If the infection is mild, the entire process may regress, leaving no trace of previous disease, or an abscess may form and subsequently be absorbed or break into the gut or be drained externally by the surgeon. Which-

ever may happen the irritation subsides, and the absorption of the exudate about the infected area takes place. The gut walls and the omentum reduce in volume, their density becomes less, and they are once more supple. As this process of absorption takes place within the interstices of the tissue, the exudate on the surface of the peritoneum, in the chinks and crevices, likewise becomes absorbed. As this occurs the organs which were attached to each other become loose, and the adhesion has freed itself.

Causes of the Migration of the Omentum.—So marked is the tendency of the omentum to appear at the site of infection that observers have been enthused into the use of poetic expression thereon. Morrison ("Remarks on Some Functions of the Omentum," Brit. Med. Jour., 1906, i, 76) referred to it as the "policeman of the abdomen." This, like most poetic flights, may bear truth without, however, carrying an explanation.

The general impression seems to be that the omentum undergoes its changes in position while in the normal state. This is not true. The normal omentum does not migrate. There are certain definite cellular and exudative active processes which precede any change in position. These may be summed up as follows: When a bit of great omentum is irritated it responds by the production of an exudate composed of cells and serum upon and beneath its endothelial surface and about its vessels, so that it becomes many times its normal thickness. When the irritation is but moderate the cellular elements may be represented both by the polynuclears and the mononuclears; when more intense, the polynuclears are almost the chief representative early in the process. Simultaneously with the development of this exudate and the mobilization of the cells above referred to, the omentum, or the

portion of it so affected, migrates toward the area of infection.

The answer to the question as to why the omentum seeks the site of infection, is not easy to give; but little has been written upon the point worthy of record. Adami ("The Great Omentum," Philadelphia Med. Jour., 1898, i, 373) complains of the paucity of the literature. Since that date a number of papers have appeared which present some speculations on this subject. Fischer ("Some Functions of the Omentum," Brit. Med. Jour., 1906, i, 235) believes that peristalsis accounts for the movements of the omentum. When inflammation hampers the movements of the intestine the more actively moving peristalsis in the non-inflamed areas moves the omentum toward the affected area. Dickinson ("The Omentum and Its Functions," Ann. Surg., 1906, xliv, 652) ascribes its movements to the pumping action of respiration and to peristalsis. Adami (l. c.) observed that in one bedfast, long the victim of disease, often has his omentum dislodged to the region of the colon or above. Gravity and peristalsis may here play a part, but the conditions here are wholly different from those which obtain when there is a movement toward a focus of reaction.

My own studies ("Causes of the Migration of the Omentum," Jour. of The A. M. A., 1913, lx, 1292), while suggestive, are recognized as inconclusive. The best that can be done is to trace a similarity of its conduct with that of the leucocytes.

Two methods may be followed in studying this problem. The one consists in the study of the omentum itself under conditions simulating those occurring in disease by directly observing its movements through a window placed in the abdominal wall of an animal; the other is the study of an artificial omentum under the conditions and environments of the natural one.

Following the first plan, a window may be placed in the abdominal wall so that the conduct of the abdominal organs may be observed over an indefinite period of time. If now a foreign body, as a pledget of sterile gauze, be placed within the abdominal cavity within the range of vision through the window, but away from contact with the omentum itself, the behavior of the latter can be followed. It is noted that an exudate composed of fibrin-forming elements, together with leucocytes, the result of irritation, forms about the foreign body. Quickly following this, an exudate occurs in the meshes of the omentum and on its surface. This accomplished, the omentum proceeds toward the foreign body, and the exudate on the surface of the omentum becomes fused with that about the foreign body. The explanation of these phenomena may be tentatively offered as follows: the fibrinous exudate, together with the contained cells, forms about the foreign body as a direct result of the irritation; and the reaction is transmitted to the surrounding tissue, as evidenced by the fact that the peritoneum in the neighborhood becomes hyperemic to a greater or less extent. The vessels of the omentum share this general reaction, and respond by a pronounced serous and cellular exudate. The conglomeration of leucocytes is held together by the delicate meshwork of the omentum, and, responding to the influence that draws any leucocyte to an area of infection, the leucocytes proceed to it, and incidentally carry the omentum with them. In favor of this hypothesis it may be noted that the cells in the free exudate on the surface of the peritoneum proceed to the point of irritation; and, since the inflamed omentum is made up largely of leucocytes, it seems reasonable to suppose that the tissue of the organ follows along as an incidental factor. When there is no leucocytic infil-

tration of cells into the omentum, as in the extremely virulent infections, there is no migration.

The use of the window makes it possible to study the influences of position, intestinal distention, and peristalsis. Unfortunately, usually by the time the omentum becomes sufficiently infiltrated that its weight might act in response to gravity, it has become attached at the site of irritation. The normal omentum is not influenced by position in the presence of normal intra-abdominal tension. In the tympanitic abdomen the omentum follows the line of least resistance, but there is no evidence that this influence is a factor capable of propelling it toward the site of disease. It remains for someone to suggest that the hyperemia attending the reactive processes increases the weight of the organ, and adds to its disposition to fall toward the affected area. The same may be said of increased peristalsis. The omentum does not move until infiltrated, and when once infiltrated peristalsis cannot move it. It is then so rigid that the intestines glide beneath it. On the other hand, if the intestines become adherent peristalsis ceases, and they become distended, in greater or less degree.

The rate of migration of the omentum may be studied by means of the *x*-ray. Small shot may be fastened to the omentum, and a source of irritation set up within the abdomen, as above described. By repeated observations with the *x*-ray the gradual change in position of the shot may be followed. This is a complicated experiment and is subject to many variations, but, so far as conclusions are warranted from a mean of many experiments, the migration of the omentum may be said to be complete in from four to eight hours, when the stimulus is the result of irritation from a gauze pledget.

The other method of study consists in the use of

sheets of corn-pith placed free in the peritoneal cavity at some distance from a pledget of gauze or in a wound of the peritoneum. The surrounding tissues become infiltrated as before. An exudate is also formed in the region of the corn-pith. It becomes infiltrated with peritoneal exudate, including an abundance of cells. This mass consisting of the foreign body and the contained cells then gradually moves toward the gauze pledget or the wound in the peritoneum. If the gauze pledget or the peritoneal wound cause too little secretion or the corn-pith is too far away from this region, the migration may not take place. If the corn-pith itself excites too great an irritation it may become attached, and therefore be unable to move, or it may become imprisoned in a fold of peritoneum. Therefore in performing these experiments many negative results must be expected. A wholesale experiment may be performed by placing many corn-discs in various regions of the peritoneal cavity of a single animal. The incision in the peritoneum is allowed to remain unsutured, closing simply the fascial and skin layers. This forms an active field for the attraction of foreign bodies. When the abdomen is opened some days later an astonishing number of these discs will be found adherent to the wound in the peritoneum at the site of incision.

Why this migration of omentum and a cell-laden foreign body takes place, is as great a mystery as why leucocytes migrate. It is likely a physico-chemical problem, of which we are only beginning to gain a faint glimmering of intelligence. That there is a striking similarity in the response of the omentum to irritation to that of the leucocytes, is apparent to anyone who has studied the problem first hand. If one knows what the leucocytes will do in response to a given irritation the conduct of the omentum may con-

fidently be predicted. If we are to speak of the "intelligence" of the omentum we may safely add that an individual's omentum is as smart as his leucocytes. The best answer to those who would give way to outbursts of poetic enthusiasm when contemplating the functions of the omentum, is given by Welch, in speaking of the omentum ("Adaptation in Pathological Processes," Tr. Cong. Am. Phys. & Surg., 1897, iv, 291) in the following words: "We see here, as elsewhere, that Nature is neither kind nor cruel, but simply obedient to law, and therefore consistent."

Influence of Species of Bacteria on the Formation of Temporary Adhesions.—Conditions of the environment and the general state of health of the patient exert a powerful part. Individuals long sick with a disease not involving the peritoneum show a lessened resistance to the spread of any infection which may larly true in those diseases characterized by a hypoleucocytosis. Perforation in typhoid fever or in cholecystitis long accompanied by jaundice, offers little resistance to the spread of infection.

The fact that the infections of the abdomen are seldom the product of a single variety of organism makes the specific characterization uncertain. The gonococcus, with its great capacity for the excitation of fibrous exudate, is the most active organism in the excitation of temporary adhesions. The pneumococcus also possesses these characteristics in a marked degree. The staphylococcus in pure culture is prone to produce an extensive degree of infiltration and adhesion-formation. The colon bacillus, with its capacity to prevent fibrin-formation and to dissolve fibrin when once formed, permits of a less secure barrier-formation than the less virulent staphylococcus. The still more virulent streptococcus, with its repellant action against fibrinous exudate and leucocytic attrac-

tion, prevents any effort at barrier-formation. Various bacteria, acting in conjunction or in sequence, may form a bewildering kaleidoscopic picture that fascinates and baffles the mind of the observer. In the pelvis, for instance, the gonococcal perisalpingitis institutes a line of reaction which may be markedly modified by the appearance of colon bacilli. We then observe the conflict of two varieties of bacteria and the resistant forces of the pelvis, each clamoring for the center of the stage.

Not alone do the several varieties of bacteria enter to make the processes confusing. The ferments of the gut tube add their part. As already noted, perforation with the escape of ferments may dominate the entire picture.

The intricacies of intraperitoneal infections and the defensive forces, serous and cellular, acting against them, present a problem against the solution of which there has been but little talent applied. Abandoned by the pathologists and the bacteriologists, and unheeded by the surgeon, this marks the barrier across the path of advance of abdominal surgery of the present day. There is pleasing activity among the anatomists at the present time in the study of tissue reactions and cellular characteristics, and we hope for a securer basis when the study is again taken up.

Prognosis of Temporary Adhesions, Per Se.—It may be repeated here that the purpose of temporary adhesions is to prevent the spread of irritative processes, and, having performed this function, they loosen. Simple as the problem is in the abstract the judgment in a given case requires careful consideration. A few general rules admit of definite statement. When an adhesion has become vascularized and is supple it is apt to be permanent; nevertheless, if there is much traction on an adhesion the interference with

its circulation by the traction may gradually lead to its release. If, on the other hand, it is dense in consistency, uniform in color, and brittle in its attachment, it will loosen after the call for its service is ended. If the character of the disease process is kept in mind the ultimate fate may confidently be predicted. What is best for the patient is what will likely happen.

Management of Temporary Adhesions.—Temporary adhesions are purposive in character, and are brought about in the interest of the patient. Before interfering with the attachment of the adhesion the surgeon should know definitely what he desires to accomplish. Generally speaking, only so much of the adhesion should be broken up as will permit of the accomplishment of the specific purpose for which he is operating. For instance, in acute appendicitis the more directly the surgeon can proceed to the offending organ, and the less he disturbs the protecting adhesions, the less he menaces the patient. If the surgeon attends to the removal of the offending organ, natural processes will loosen the adhesions with much less risk and with greater delicacy than the surgeon. Cullen ("The Surgical Method of Dealing with Pelvic Infections," Surg., Gynec. and Obst., 1917, xxv, 134) has advised the excision of the acute adhesion when possible. In omental adhesions to the appendix, for example, he advises the section of the omentum beyond the site of infection and the removal of the remaining portion with the appendix. In subacute inflammations this may be safe, but it involves a more extensive operation and deprives the patient of that which once saved him from a general infection. This procedure can be practiced safely only by past-masters in the art of surgery.

Unnecessary interference with adhesions may permit the spread of the infection, if it be virulent, lead-

ing to infection of previously unaffected regions; or, if the infection be mild, a loosened adhesion may become attached to a previously unaffected region, and there form a permanent one.

To these possible disasters may be added the inadvertent injury of surrounding structures. These accidents, it is true, haunt the path chiefly of the beginner, but experienced operators sometimes are chagrined by the sudden appearance of mucous membrane.

As a warning to the beginner, it may be pointed out that, in addition to the above-mentioned dangers, it is difficult to determine the limits of adhesions in the acute stage. Normal folds and plicæ, when enlarged by edema, may simulate formidable adhesions, challenging the interference of the surgeon. Yet these, if untouched, regress as the infection subsides and the normal is restored, but, if inadvertently interfered with, they may jeopardize the nutrition of an important organ.

DISCUSSION ON THE TWO PRECEDING PAPERS

Dr. E. P. Quain (Bismarck, N. D.): Three years ago now I had the privilege of reading before this Association a report of the experiments referred to by Dr. Corbett. Since then I have done several additional experiments of the same kind and always with the same general results—either adhesions or a white, thickened, infiltrated, and edematous serosa on the enervated side in the majority of the experiments.

One strong criticism could be stated against the technic employed in many of those experiments, and that is, that in several lateral incisions only the visible intercostal nerve trunks were severed near the costal margin. It is quite certain that in those cases only a part of the nerve supply of the serosa in question was severed. At the point where the intercostal nerves enter the abdomen between the internal oblique and the transversalis muscle there is a network of intercommunicating nerve fibers in the areolar tissue. From the loops of these fibers are given off innumerable filaments in fairly straight lines, piercing the transversalis muscle and

fascia, and finally ending on the serosa as far as the linea alba. In order, therefore, to sever all intercostal nerve supply to a segment of peritoneum, it is necessary to cut through all tissues between and including the visible nerve trunks. Had I done this in all my experiments I am convinced that my results would have been even more decisive.

The nerves visible to the naked eye near the semilunar line have nothing whatever to do with the peritoneum. These nerves supply only the rectus muscle and the skin. This fact should be thought of by those who claim that they successfully "conserve" the intercostal nerves in the incision with the idea that no damage has been done to any of the tissues mesial from the incision. We cannot make a longitudinal lateral incision into the abdomen, especially near the semilunar line, without severing all intercostal nerve supply to the peritoneum internal to the incision.

The question which every operator must settle in his own mind is whether, in a given case, for exploration or for surgical therapy, he is justified in inflicting this injury by a longitudinal lateral incision. In my opinion there are times when such an incision is necessary; but there are more times when it is not necessary, and there are times when it is absolutely inexcusable.

From time to time I see this condition demonstrated clinically, and I think that we must accept it as a fact that postoperative visceroparietal adhesions are more apt to occur on a peritoneum minus intercostal nerve supply than on the normal serosa. It is one of the many causes which aid in the formation of adhesions. We should consider normal nerve supply to this part of the anatomy of, at least, as great importance to the individual as when we make incisions into other parts of the body.

The citrate method referred to by Dr. Corbett undoubtedly is of practical value as a chemical means of preventing adhesions. It has, however, not yet been sufficiently tested to demonstrate its exact field of usefulness. I have employed it in a few cases, but my observations have been too limited to warrant a rehearsal at this time.

I wish to refer to two cases—reports out of many which have appeared recently in which the great value of the citrate method was demonstrated and recommended. In each case the report is from a very prominent American surgeon. One was in the case of an acute appendicitis, operated on through a

pararectal incision and, so far as the record shows, without drainage. This patient was re-operated on three times within the next two years for acute intestinal obstruction from post-operative adhesions.

The other report is that of a chronic appendicitis operated on through a right rectus incision. In the following four years this patient was re-operated on four times for acute obstruction from adhesions. The report says, "From all five operations the patient had three abdominal scars, one at the original site of the first operation, another through the right rectus muscle to the inner side of the first scar, and the last on the left side through the left rectus muscle."

Both these patients were reported free from their previous symptoms after the introduction of a large quantity of the citrate solution in the last operation, in each case. So far, so good for the citrate method. But to me this question stands open: If in the primary operation in each of these two cases the pararectal and the right rectus incision had not been used, would the following third and fourth operations for adhesions and obstructions have been called for?

Rough and unsurgical treatment of the peritoneum, introduction of irritating substances, together with careless removal of infective products during operations, are the main causes for post-operative adhesions. But it is not fair to blame ourselves for all the peritoneal adhesions that may follow an operation.

It has been shown that anaërobic intestinal bacteria can, and often do, enter the peritoneal cavity, and cause chronic adhesions. It is not impossible that such bacteria, under certain operative conditions, may invade the peritoneum and cause adhesions.

Dr. H. T. Byford (Chicago): I desire to call attention to one fact that is important in connection with adhesions. As we do not introduce chemical agents into the abdominal cavity, and as in clean or non-septic cases we do not ordinarily introduce sepsis to amount to anything, traumatic irritation is the cause of a large number of these adhesions. In considering them we have to think of omental adhesions as being generally permanent, while adhesions of the small intestines are temporary. If the intestinal adhesions are to the omentum, they may be permanent because the omentum moves with the intestines and the intestines cannot draw themselves loose as they do from fixed organs.

Painful contractions of the intestines do not usually follow operations unless there is injury of the peritoneum. In peritoneal sections for operations on the pelvic organs, the longer the incision, the greater the difficulty of keeping the intestines out of the way. I have seen so many patients who had been operated on through a long incision, who suffered for years from the results of the operation, that, whenever practicable, I operate through a short incision. In surgery of the upper abdomen there is less objection to a long incision because the intestines can be kept out of the way more easily. The pelvic organs can be brought to the surface through small incisions, and most of the work done extraperitoneally.

Long incisions should, by all means, be made in cases requiring them, but I make these remarks for the sake of protesting against always making an incision large enough to open up the entire pelvic cavity to view before ascertaining that it is necessary or desirable. When in doubt a short exploratory incision large enough to admit the half hand should be made first.

Dr. Leonard Freeman (Denver): We should not get hysterical about peritoneal adhesions. As has been so strongly emphasized in Dr. Corbett's excellent paper, peritoneal adhesions are not abnormal and harmful things, but are, in most instances, normal and harmless. Nature uses these adhesions on the inside to protect and approximate, much as the surgeon uses adhesive plaster on the outside; and, like the plaster, the adhesions are often removed when their purpose has been accomplished.

It is only rarely that harm results from peritoneal adhesions, and then the harm is in the nature of an accident, as it were, something which happened owing to a particular concatenation of circumstances. For instance, an operation is done for appendicitis, and an adhesion results which kinks the bowel. This same operation might be done in the same way hundreds of times without such an accident occurring again. Also, if this band be divided, the kink is not likely to recur, even if raw surfaces are left and adhesions re-form. Almost every surgeon must have had such experiences.

Hence, bearing in mind the great likelihood of the relief of symptoms by simply dividing the adhesion without doing anything more, it is obviously impossible to judge of the merits of any given method of preventing adhesions by clinical ob-

servation alone. To say that a given method is a success because no symptoms of adhesion have followed its use, or because such symptoms have been relieved, is illogical.

Therefore, the value of methods for the prevention of peritoneal adhesions must be settled by animal experimentation, by re-operation, or by autopsy. Animal experimentation is obviously the best method, because the condition can be accurately predetermined, and the experiments repeated, checked up, and controlled as much as may be necessary.

In this connection some very convincing experiments were made some years ago in the laboratory of the University of Pennsylvania by Craig and Ellis. They worked principally with Cargile membrane (prepared peritoneum of the ox), very highly lauded by Robert Morris for the prevention of adhesions. They found that it not only did not prevent peritoneal adhesions, but actually made them worse. They also came to the conclusion that this was true of all dead substances, animal or otherwise, these substances acting as foreign bodies, whether absorbed or not, and giving rise to adhesion by their irritation.

Others, as Dr. Corbett, have arrived at similar conclusions from experimentation.

What we need, then, is careful experimentation and not clinical reports, and Dr. Corbett is unquestionably giving us what we need, for which we should be duly grateful.

I am inclined to think the best thing to use to prevent adhesion is omentum, as a free graft or otherwise. In a case in which I used a large piece of omentum to cover a raw surface resulting from a cholecystectomy, I opened the abdomen a year afterwards for another purpose. The omental graft presented the appearance of fibrous tissue, but its surface was smooth and glistening and free from adhesion to the colon, which lay against it.

Dr. A. T. Mann (Minneapolis): Just a word in regard to this question of transplanting peritoneum. These papers have been so illuminating and so fine that I think they convey their own message, and need very little discussion.

I had occasion to go into an abdomen in which the uterus was retroverted; the broad ligaments were all fastened, together with the back of the uterus, to the bowels and to the pelvic wall. When I raised it up we had a raw surface over the entire area. To cover that I looked at the omentum, and found it was favorable for a transplant, and I transplanted

the entire omentum, tying it off straight across close to the transverse colon, and tucked it down into place, behind the uterus and back of the broad ligaments, using just a few stitches in the top, and the bowels as they came down, pressed it forward into contact with the raw surface of uterus and broad ligaments. Two years later this patient came in with an ovarian cyst on the other side. I saw the omentum smoothly grown to the back of the uterus, to the back of the broad ligaments, and down to the ovary. It was smooth, and the fat was all gone. It looked like peritoneum, about twice the thickness of the normal peritoneum, and the surface slid about easily under the finger. The bowels were not adherent.

Dr. Corbett (closing on his part): I shall take only a minute or two in making my closing remarks.

Dr. Hertzler has shown beautifully how adhesions form,—first the laying down of fibrin, then the growth of connective tissue cells. Coincident with the laying down of the fibrin we have certain attempts on the part of the leukocytes through proteolytic action to dissolve the deposited fibrin. This brings up the question whether we are justified in imitating this process of nature in using peptone or citrates in the abdominal cavity. From the vast amount of experimental work done I should say that we are absolutely not justified in using these agents to inhibit the formation of fibrin. Let us go one step further and take the fully developed adhesion, or the kind of adhesion which forms in spite of the efforts of nature to loosen adhesions, and I believe its history will show that they depend on blood supply.

I did not want to convey the impression that the omental graft could in any way cause adhesions. On the other hand, if we use omental grafts to cover over raw surfaces, they always cure the disastrous effect of the adhesion by mobilizing the viscera.

I want to emphasize what Dr. Quain said. The right rectus incision when cutting more than two nerves is often responsible for adhesions.

MISCONCEPTIONS OF THE SURGEON CONCERNING RECTOCOLONIC AFFECTIONS

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Yearly, proctologists encounter patients who have been operated on by surgeons without relief. The average surgeon, apparently, does not realize that methods of diagnosing and dealing with rectocolonic affections have undergone radical changes, and he treats them in ways abandoned by up-to-date specialists. The object of the paper is to correct some misconceptions of, and call attention to the more common mistakes of, physicians and surgeons doing rectal work.

Many diseases of the anorectal region are difficult to cure, yet most doctors believe they are capable of dealing with them, while results show they are not. Failure in most instances is traceable to an improper examination, incorrect diagnosis, unsuitable preparation of the patient for operation, wrong method of anesthetization, poor surgical technic, or faulty postoperative treatment.

Physicians should stop making a rectal diagnosis (usually piles) from *finding* blood upon the clothing or from the patient's statement that he has rectal pain or that something protrudes through the anus.

There is no longer excuse for not correctly diagnosing anorectal affections, for they can be seen or palpated *externally,* or felt with the finger or inspected through the proctosigmoidoscope when *internal.*

Many mistakes would be avoided if the examiner understood that 90 per cent of rectal diseases,—namely, hemorrhoids, fissure, fistula, ulcers, enlarged papillæ, inflamed crypts, polyps, and venereal lesions,—are encountered in the anal canal, and if he carefully examined this region, instead of immediately introducing his finger into the upper rectum.

Of these conditions papillitis, cryptitis, and blind internal fistula are often overlooked or mistaken for another affection.

Too much reliance is placed upon fecal analysis and radiographs, and too little on symptoms and a common-sense examination.

Preparation of Patient.—The practice of purging patients and deluging the colon with enemata prior to rectal operations is wrong, since they liquefy the feces, which favors soiling of the operative field, and subsequently causes tenesmus, unnecessary painful stools, and fouling of the dressings.

For fistula, hemorrhoidal fissure, polypoidal, and other minor anorectal operations, the preparation made by the writer consists in having the sufferer take a mild laxative the night before and cleanse the rectum with a six-ounce enema just before operation. Then, with the patient in the left Sims' posture, the rectum is swabbed with an antiseptic solution, and iodine is painted over the peri-anal skin. Small enemata clear the rectum of solids without liquefying the feces higher up.

When the colon or rectum is to be amputated, resected, or anastomosed, and stitching is necessary, two days' preparation is required in order that the colon may be emptied, cleansed by catharsis and high enemata, and then tied up with an opiate or astringent, so that the bowel will be clean and dry if opened.

Shaving is omitted except where primary union is

sought following stitching because outgrowing hair-stubs cause intolerable itching and sticking sensations.

Anesthesia.—Why surgeons extensively employ general anesthesia in this work is beyond understanding since more than 80 per cent of rectal patients can be effectively and painlessly operated on under infiltration anesthesia. The writer has successfully performed more than five thousand operations in the anorectal region under sterile water or a one-eighth of one per cent eucaine anesthesia without a serious complication or death; but a eucaine solution is preferable to the former because the initial injection of water induces slight pain.

Complete anesthesia follows within twenty seconds after infiltration of the part unless the solution escapes through an ulcer, fistulous opening, or needle-puncture, and desensitization is due to the action of the drug and the degree of pressure exerted by the fluid.

Stovain, novocain, and like chemicals are effective, but possess no advantage over nontoxic eucaine, which has been exclusively employed by the writer for fifteen years.

Adrenalin is no longer employed with eucaine, since it contracts and later causes relaxation of vascular tissue, and the writer prefers immediate to subsequent hemorrhage that he may arrest it before adjusting the dressings.

Tissues can be anesthetized with quinine and urea, which prevents post-operative pain, but the solution is undesirable, since it induces sloughing or delayed healing.

Local anesthesia is contra-indicated when the operator does not know what is required before the operation is begun, and when a simple complicates a serious rectal affection.

General or spinal anesthesia is necessary for rectal resection or amputation and for extensive operations for procedentia, tumors, large abscesses, complicated fistulæ, and stricture; and infiltration anesthesia is unsuitable for most colonic, sigmoidal, and other addominal operations.

Eucaine may be employed in any quantity, and is injected until the tissues are whitened, which indicates complete anesthesia. The syringe should hold two or three ounces, and be fitted with a Gant goose-neck attachment, which enables the operator to keep the needle point in view.

The writer tells his patients they will feel the initial injection, but not the operation, otherwise they squirm when the needle is introduced.

Post-Operative Treatment.—Failure in anorectal work is more often due to faulty post-operative treatment than defective operative technic.

Many post-operative complications are directly due to the unnecessary use of stitches, daily packing, instead of lightly draining the wound, and removing too much peri-anal skin.

Secondary hemorrhage is rarely encountered where spurting vessels are tied, or the wound is closely packed with gauze except during vomiting or straining following etherization, and when the dressings are improperly supported by a weak or poorly adjusted T-binder.

Management of the stools following operation worries most operators. Some operators purge the patient, and keep the evacuation fluid, while others tie the bowel up.

Frequent fluid stools are contra-indicated because they are accompanied by straining, induce unnecessary pain, favor hemorrhage, soil the dressings, and catch in wound-pockets to cause infection; and constipated

movements are objectionable since the passage of hard fecal masses is accompanied by excruciating pain, lacerates the wound, and delays healing.

The writer attempts to procure a full soft evacuation daily with fruit, olive or mineral oil, saline water, or a dinner-pill.

Many operators keep patients upon fluids following fissure, and hemorrhoidal and fistula operations; but a liberal diet is preferable, since the patient retains his strength, and full soft evacuations cause little suffering.

Keeping patients in bed for several days or weeks following minor rectal operations is a mistake, since they are happier up and about, which does not delay healing of properly dressed wounds.

Phthisical individuals and those having tubercular fistulæ should be operated on under local anesthesia, and kept in the fresh air, for they often die shortly following etherization and when detained in a poorly ventilated room.

Fissure.—Sphincteric activity prevents healing of fissures, and the plan of cauterizing them with copper or silver and acids is bad, since they incite the anal muscle to tonic contraction, induce more pain than an operation, and prevent healing of the rent.

Divulsion of the anal outlet in conjunction with topical applications and softened evacuations is effective when healing takes place before the sphincter regains its tonicity, but the procedure is impracticable when the rent is old and edged about with scar tissue.

Excision of fissure is to be condemned because the operation requires considerable time, infection frequently follows, and the patient is not cured unless the muscle has been severed.

Division is the procedure of choice for fissure-in-ano, because the operation can be painlessly performed

under local anesthesia in five minutes, is invariably successful, and confines the patient to bed but one or two days.

The writer splits the lower two inches of the rectum, the sphincters, fibers of the levator-ani muscle, and fissure posteriorly with a blunt-pointed bistoury following eucainization of the tissues. He has performed this operation five hundred times without a failure or serious complication; and in nearly every instance widening the anal canal also relieved constipation and painful defecation, and insured the sufferer against future tears. Agonizing pain is immediately arrested, and healing ensues promptly without topical applications, when the wound is lightly drained and mucosa and skin are prevented from growing into the cut and separating the sphincter ends.

Hemorrhoids.—Internal, varicose, capillary, external cutaneous, and thrombotic piles are invariably operated on under eucaine anesthesia except when complicated by another affection; and when surgeons are unable to operate, except under general narcosis, they do not understand the technic of infiltration anesthesia.

Cutaneous hemorrhoids are injected and excised without approximating wound edges, and thrombotic piles are distended, transfixed, and slit open with a curved bistoury, after which the clot is evacuated, loose skin is removed, and the tumor cavity is packed to prevent further bleeding.

Strawberry or capillary piles are infiltrated, and snipped off or destroyed with the Paquelin cautery in a moment at the office, the patient's home, or the hospital.

Venous or varicose internal hemorrhoids are painlessly removed, barring the initial sticking of the

needle, by the ligature, clamp, and cautery, or modified excision operation.

The writer will not discuss Whitehead's operation because it is brutal, often accompanied or followed by complications or sequelæ, and is no more curative than other procedures.

The writer has treated three hundred patients permanently invalided by Whitehead's or Pratt's American excision operations who doubtless could have been cured by a ten-minute local anesthesia operation that would not have left sequelæ.

The theory of excising the pile-bearing area to forestall the formation of hemorrhoids subsequently, is enticing, but there is no more sense in removing normal rectal tissue than healthy veins from one leg because those of the other are varicosed.

Results are satisfactory following the clamp and cautery operation, but the procedure has objectionable features, namely: an extra assistant is required to handle the cautery, which usually works except when you need it; alarming hemorrhage sometimes follows where hemorrhoidal stumps are not thoroughly cauterized, or they are pulled apart by sponging or introduction of the finger, instrument, or gauze into the rectum, slipping of a T binder or pressure-pad during post-operative vomiting or straining, and it is difficult to keep the patient from squirming when local anesthesia is employed, because the patient sees the glowing cautery-point, has an idea somebody's going to be burned, and thinks he knows who it is.

Internal venous hemorrhoids can be excised without difficulty under eucaine anesthesia in successive stages by cutting and then suturing the wound, as piles are removed.

This is preferable to other methods of excising hemorrhoids, because strips of healthy mucosa are left

between the wounds, but is objectionable because it induces considerable post-operative pain, keeps the patient in bed for several days, and is frequently followed by infection and the formation of an abscess or fistula.

The ligature is the procedure of choice for local-anesthesia hemorrhoidal operations because it is effective, is performed in less than ten minutes, and is seldom followed by secondary hemorrhage, infection, or other complications.

Formerly when the writer employed heavily plaited silk, tied three-story knots, and ligated the skin and tumor *en masse,* pain and inability to void the urine were frequent post-operative manifestations; but since he substituted linen for silk, and began dissecting piles upwards and ligating vessels only, these complications have been practically eliminated.

Large protruding internal hemorrhoids are more quickly operated on under local anesthesia than small piles, because they are easily reached.

For the benefit of surgeons who have difficulty in extruding hemorrhoids, I will enumerate the methods of bringing them into view. It is done with a suction-pump, by everting the anal margins, pushing them out with the fingers in the vagina, introducing several rosin-covered tampons into the rectum through a proctoscope and simultaneously withdrawing them, rolling them out with a speculum by tilting it as withdrawn, injecting the tumors through the window of a speculum and withdrawing them with forceps, and by having the patient strain or take an enema to make his piles protrude before getting upon the table.

The writer never employs gauze-covered rubber tubes in hemorrhoid operations, since they are unnecessary, and induce constant suffering, and excruciating pain when removed.

Bleeding from skin cuts is arrested by a pressure-pad supported by a tightly adjusted T-binder.

The writer regrets that he has not the time to describe the ways of quickly and absolutely controlling post-operative, anorectal hemorrhage.

Fistula.—Surgeons who successfully remove segments of the brain, spleen, colon, or a leg, frequently fail to cure fistula because they lose their nerve and hesitate about severing the sphincter. In no other field is their surgery so poor as in the treatment of fistula; and the writer is consulted almost daily by patients suffering from fecal incontinence or fistula unsuccessfully operated on one or several times. Many physicians believe that most fistulæ are tubercular, and they decline to operate when the percentage is less than 5 per cent.

Whether one operates does not depend on the tubercular nature of the sinus, but upon the patient's vitality; for neither ordinary nor tubercular fistula wounds heal when the patient's health has been greatly depleted by phthisis or other exhausting disease, but both are curable when his strength is sustained.

Tubercular sinuses are easily distinguished from ordinary sinuses by their large irregular-shaped internal and external openings, undermined drooping bluish skin edges, copious thin rice-water-like discharge, absence of peri-anal fat, abundance of fine silky hairs on the buttocks, and the patient's cachexia, loss of weight, and lung manifestations.

Such tracts are secondary to infection of the intestine or lung in 95 per cent of the cases.

About 75 per cent of fistulæ are submucous and subcutaneous, or traverse superficial fat, and are operable under local anesthesia, while the remainder penetrate deeply into the muscles, fascia, or rectum and require general narcosis.

The writer does not hesitate to operate upon multiple, lengthy superficial fistulæ under eucaine anesthesia, but never attempts division or excision of deeply burrowing tracts or those secondary to rectal stricture, cancer, ulceration, or bone disease except under gas-oxygen, ether, or chloroform anesthesia.

Ether is contra-indicated when the patient has latent or active tubercular foci in the lung because it aggravates the condition, which terminates fatally in a few weeks or months. Tubercular subjects following fistula operations do much better when kept in the open air, instead of in bed in a poorly ventilated room.

The surgeon's failure to cure fistula and fecal incontinence is usually traceable to an imperfect surgical technic or *faulty* post-operative treatment, such as cutting the sphincter obliquely or zigzag fashion, instead of at a right angle; firmly packing, instead of lightly draining, the wound; permitting skin or mucosa to grow into the cut; destroying healthy granulations by cauterization; unnecessary pulling apart or probing the wound; permitting dressings to become soaked with pus, which delays healing; and needlessly dividing the sphincter at two or more points.

Formerly the writer believed fecal incontinence was due to severing the internal and external sphincters, but he no longer hesitates about dividing both when indicated.

Correction of Fecal Incontinence.—Operators needlessly waste time in attempting to locate, free, and suture the separated sphincter ends, which is often impossible, since they are thin and atrophied, and cannot be isolated or tear apart when united.

Operation for Fecal Incontinence.—The following embrace the steps in the writer's local anesthesia operation for fecal incontinence: (1) the tissues at, above, and below the point of leakage are infiltrated

with eucaine until blanched; (2) the sulcus and adjacent cicatricial tissue are seized with tenaculum forceps, held, and excised with a diamond-shaped flap, including a segment of the rectum, the muscle ends, and the skin by two incisions that cross the sphincter not less than half an inch apart; (3) the edges of the wound beneath the mucosa are accurately approximated by buried interrupted chromic catgut sutures that pass external to or beneath the cut; (4) the mucosa is dissected free, and, after a strip on either side has been removed, its edges are sutured with plain catgut to the right or left of the wound to minimize danger from infection; (5) the skin wound is closed with plain gut, and protected by gauze introduced into the rectum.

In 17 cases thus operated on, the results were as follows: Fecal incontinence was completely relieved in 9 cases, diminished in 5, slightly reduced in 2, and no benefit was observed in 1.

Constipation.—Constipation is congenital or acquired, and is of four types, viz: psychic, atonic, spastic, and surgical.

Surgical constipation, or obstipation, may be divided into abdominal, induced by Lane's kinks, adhesions, strictures, diverticula, Jackson's pericolic membrane, foreign bodies, enteroptosis, angulation, ileocecal incompetence, invagination of the sigmoid flexure into the rectum, extra-intestinal pressure, and anorectal, when the block is located in the terminal bowel.

Anorectal constipation may be caused by a growth, stricture, or inflammatory lesion, but in 80 per cent of the cases it is induced by hypertrophy of the sphincter or levator-ani muscle, narrowing of the anal canal, anterior coccygeal deviation, thickening of the rectal valves, hypertrophy of O'Beirne's sphincter, or some

anorectal affection that incites sphincteric spasm or obstructs the upper rectum or anal canal.

Abdominal constipation has been unduly emphasized since Lane's visit to this country, and hundreds of patients are being killed yearly or made chronic invalids by inexperienced and incompetent surgeons who excise the colon or short-circuit the bowel without due provocation or insuring against subsequent stasis.

The writer believes Lane's colectomy and short-circuiting operation will soon become as unpopular as his bone-plates now are.

Surgeons cannot successfully compete with recto-colonic specialists in relieving surgical constipation until they give the subject more attention, and learn to differentiate between colonic, sigmoidal, and anorectal blocking, which is not difficult if a clear history is obtained, the abdomen is carefully palpated, and the rectum and pelvic colon are examined with the finger, and inspected through the sigmoidoscope.

Abdominal constipation is characterized by localized accumulation of gas, and soreness, producing a feeling as if the passage of the bowel content were arrested at a definite point; movable fecal tumors in the colon, or sausage-like feel of the sigmoid when distended with feces; enormous amount of water (two to six quarts) required to procure an evacuation; absence of a desire to stool; and an empty rectum except following a laxative or enema.

Patients suffering from anorectal constipation frequently complain of sensations of weight and fullness in the rectum, a desire to stool with inability to empty the bowel, backing up of gas, and a shut-off sensation as the feces are about to be expelled when the sphincter or levator-ani muscle is hypertrophied.

When daily evacuations can be obtained with small enemata (four to six ounces) the block responsible

for costiveness is located at the anus or in the rectum. In such cases repeated examination with the finger and proctoscope demonstrates that fecal matter is deposited in, but cannot be expelled from, the lower bowel. Further investigation usually proves that a tight anus, a narrow anal canal, or a hypertrophied levator-ani muscle is responsible for delayed or incomplete evacuations. When costiveness is induced by thickening of rectal valves, feces are seen or felt resting upon these shelf-like projections.

It is fortunate that anorectal is much more common than the abdominal surgical constipation because it can be relieved or cured by a five-minute local anesthesia operation, while correction of the latter requires general narcosis and a prolonged or more dangerous operation.

Unfortunately, time prohibits my discussing the treatment of different types of anorectal and abdominal surgical constipation, and the procedures that can be relied upon to cure surgical diarrhea.

In conclusion, the writer would emphasize his belief that, if surgeons handling rectal cases improved their diagnostic and surgical technic, operated more frequently under local anethesia, kept their patients in bed for a shorter time, and more carefully looked after rectal wounds, they would obtain better results, and would soon eliminate advertising "pile doctors," which would be a God-send to the profession and the laity.

DISCUSSION

Dr. Horace G. Wetherill (Denver): Those of us who come from the State of Colorado will not agree with what Dr. Gant has said with reference to the administration of ether to tuberculous people. We have in Colorado a large number of patients of this type, and have definite views as to what may be done, and what may not be done, with safety to tuberculous patients. It is my practice to use ether anesthesia for

most operations on tuberculous patients, and I feel that we can use it with a high degree of safety. It depends, not upon the anesthetic per se, but upon how the anesthetic is given and how long and how much of it is given. If a man takes an enormous amount of alcohol, he is correspondingly uncomfortable the next day; if he takes a great deal of ether, and particularly if the ether is administered badly, he is also correspondingly uncomfortable the next day, and may be seriously damaged, as well, whether he has tuberculosis or not. My Colorado colleagues will, I believe, agree with me that ether may be safely given to tuberculous people, if properly given and administered in proper amounts.

Dr. D. P. Mayhew (Detroit): I desire to say a word or two concerning the administration of general anesthetics to patients suffering from pulmonary tuberculosis, because I take issue most decidedly with the statement of Dr. Gant. This question was raised in this Association some years ago, when Dr. Haggard read a paper on "Tuberculosis of the Peritoneum." Following that I took occasion to see whether our results in Colorado would bear out the conclusions which Dr. Haggard had brought forward.

I succeeded, in 1899, in collecting 100 cases of pulmonary tuberculosis, which were operated on for one reason or another, and later got 28 cases in which the lung condition was followed for at least one year after the operation. In all a general anesthetic was given. Of these 128 cases there were only three immediate deaths. One of these cases was a perforation of the sigmoid, due to tubercular infection. Another case was one of Graves' disease, and one case of abscess of the lung. All of them were desperate cases. The case of abscess of the lung was only operated on at the urgent solicitation of the family. Of the remaining cases, there was only one patient who died within ten weeks after the operation. It was a case of external urethrotomy for total suppression. The patient had a hemorrhage after recovery from the operation, and died rather suddenly. The remainder of the cases were analyzed as to the condition of the lungs following operation, and we found there was no great difference in the ultimate mortality or in the rate of recovery in these 125 cases as compared with a similar number of tubercular patients who had not been operated on, except there were fewer unimproved cases. These patients were taken as they came to us without selection in any way, and embraced all stages

of tuberculosis. We have proved conclusively that general anesthesia does not work to the detriment of the patient.

It may be that the Colorado climate influences favorably the course of the pulmonary infection subsequent to the operation, but we know that there, at least, we can give general anesthetics to patients with pulmonary tuberculosis with perfect safety.

Dr. Gant (closing): What the doctor said about phthisical cases standing etherization well does not agree with my experience, for I have seen many of these patients die quickly of their lung trouble following it.

Ether pneumonia following operation is quite common, and, if the drug would so irritate a normal lung, it is easy to understand how ether would aggravate pulmonary tuberculosis.

Tubercular subjects with fistula have done much better following operations since I began dividing the tract under local anesthesia, and I wish to warn surgeons against employing etherization in this class of cases.

THE TWO-STAGE OPERATION IN ABDOMINAL SURGERY: A MANY-STAGE OPERATION FOR MAKING AND CLOSING A TEMPORARY OR THERAPEUTIC ILEOSTOMY OPENING

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Howard Lilienthal, in his splendid article on the "Two-Stage Principle in Operative Surgery," published in the *Annals of Surgery,* January, 1910, makes the opening statement as follows:

> Striving toward perfection in surgery, we must make every effort to master the art of operating; yet our final goal is always the security of the patient. Our motto might well stand: Not how skillful, but how safe. It is almost axiomatic that in technical skill practice indeed makes perfect. The axiom, however, is not always so evident in the matter of judgment, for here much depends upon the individual powers of observation, which enable one to comprehend cause and effect.

Further on in his paper, he says:

> When, for sound surgical reasons, the division of the operation has been decided upon, the wishes of the patient or his friends should be disregarded if a single-stage operation is urged in order to be through with the disagreeable experience. On one or two occasions I have regretted bitterly doing too much at one time, but I have never regretted dividing the operation. What we are all working for is to save the patient —to jeopardize him as little as possible.

Lilienthal recommends the two-stage operation for—

1. Intracranial disease.
2. Intrapulmonary disease.
3. Obstruction of the bile-passages.

4. Obstruction at the pylorus.
5. Malignant disease of the rectum.
6. Hypertrophy of the prostate.
7. Suppuration of the kidney (nephrectomy).

PYLORECTOMY

Lilienthal and Crile are both particularly enthusiastic concerning the two-stage operation in doing pylorectomy. I have applied it in all cases of pylorectomy for cancer for the last three or four years, and during the past two years have used the two-stage operation in all cases in which the unilateral exclusion of von Eiselsberg or the pylorectomy of Rodman has been performed for ulcer. In addition to this, I have performed pylorectomy a number of times in cases in which a gastro-enterostomy for ulcer had been performed by other surgeons. None of the patients has shown the slightest shock from the second operation or removal. My mortality-rate in doing pylorectomy has been more than cut in two by doing the operation in two stages. In fact, it seems that the mortality-rate is practically that of the gastro-enterostomy. It may be conceded that the two-stage operation is particularly adapted to the slow operator. In my work I feel that the two-stage operation is the most valuable single principle that has been put into effect since I have been practicing gastric surgery.

ACUTE AND SUBACUTE INTESTINAL OBSTRUCTION

When an acute or subacute obstruction, the result of adhesions, bands, or malignant growth, takes place, the patient is often brought to the surgeon in a very serious condition. Such a thing as a resection operation or the extensive breaking up of adhesions and bands is a serious matter, accompanied with large mortality-rate. Such patients can often be saved by mak-

ing a quick lateral anastomosis between the distended intestine above and the collapsed intestine below the obstruction. (Fig. 1.) The obstruction having been circumvented, the patient has time to recuperate, and the obstructing cause can be removed at a later operation, as we recently had the opportunity to do in the case of a small annular carcinoma at the splenic flexure. (Fig. 2.) The patient had had total obstruction for about a week, vomiting intestinal contents. The abdomen was opened as usual through the right rectus. The small intestine and the ascending and transverse colon were immensely distended, while the sigmoid flexure was collapsed. The hand, passed well up to the splenic flexure, found a little lump not larger than a walnut, which proved to be an annular carcinoma at the splenic flexure. The large intestine was punctured with a trochar to let out the gas, and the transverse colon and sigmoid were connected by quick lateral anastamosis, requiring only about ten or fifteen minutes. The patient made a rapid recovery. Two weeks later a good portion of the descending colon, the splenic flexure, and a part of the transverse colon were removed, and the ends turned in. The patient was not at all shocked.

Such a short-circuiting operation on the small intestine for the relief of obstruction due to adhesions and inflammatory processes is one of the surest life-savers I know, and the etiological pathology can be handled almost with impunity at a later date, if necessary. As a rule, however, a second operation is unnecessary.

GALL-BLADDER AND BILE-DUCTS

There is probably no more direct indication for the two-stage operation than the acutely septic gall-bladder or obstructed ducts, in which the patient is in a pre-

carious condition. The abdomen is opened, either under a local anesthetic or gas or other general anesthetic; and gauze wicks are laid straight around the gall-bladder so as to make a wall entirely around it. Four thicknesses of guttapercha tissue are made to surround the gauze. The gall-bladder is now aspirated, a big Mayo gall-bladder ladle having been placed under the gall-bladder to prevent soiling by catching the overflow of fluid. The gall-bladder is stabbed; any stones or débris, a tube, or even a piece of gauze or guttapercha, is tacked loosely into the gall-bladder with catgut; and the abdomen is closed around this quarantine pack. The operation requires less than fifteen minutes, there is little traumatism, and the acute condition is usually relieved, even though the gall-bladder be gangrenous. A later operation, if necessary, can be done with the usual impunity, when the patient is in good condition.

THE MIKULICZ OPERATION FOR MALIGNANT OBSTRUCTION OF THE MOVABLE LARGE INTESTINE

The Mikulicz operation embodies one of the greatest life-saving ideas that has been given to us in connection with intestinal surgery. By this operation we mean the bringing out of a growth with the intestine, suturing the two limbs of the loop together, closing the parietal peritoneum around it, also the abdominal wall, opening the intestine in a few hours or days (as seems best), removing the growth by the cautery a few days later; the slow cutting together of the limbs by placing the blades of a strong forceps in the respective limbs; and the gradual increasing of the pressure until the septum is cut through. (Later, the fistula is closed, as shown in Figs. 17 to 23.)

Old and feeble patients, who could not stand a

resection operation at one sitting, stand this stage-operation perfectly.

PROCTECTOMY

In the *Annals of Surgery,* April, 1915, an article of mine was published on the "Major Procedure First in the Two-Stage Operation for Cancer of the Rectum." In this article attention was called to the fact that the statistics of the Mayo Clinic had suddenly been cut from a mortality of 25 per cent to a mortality of 12 per cent by doing the operation in two stages. The members of this Clinic had used several different methods of application of the two-stage operation. In one, a very simple colostomy was performed without severing the intestine at the first sitting; in another, the intestine was severed, the end turned in, the proximal end brought out through the abdominal wall, and the distal end dropped down into the pelvis at the first sitting. They recorded one or two cases of perforation of this segment, however, which caused them to abandon it temporarily. C. H. Mayo has recently improved this by closing the peritoneum over the stump, and doing the second, or removal, operation five or six days after the first stage, before sloughing and abscess-formation takes place.

The point we brought out was that the superior hemorrhoidal artery was ligated just below the promontory of the sacrum, a rectal tube was passed up by the growth, the end of the closed distal segment fastened to the end of the rectal tube, the tube withdrawn, and with it the distal end of the sigmoid colon was drawn through the anus. The invaginated portion was then closed with two or three sutures, and the peritoneum closed over all, making a completed abdominal operation, the fat and glands in the hollow of the sacrum having been pushed down with the rectum.

Eight cases were reported in that article with one death. Since the publication of that article I have operated upon eight other patients by this method without further mortality, making in all sixteen cases with but one other death. It will plainly be seen that this procedure can be followed only when the growth is located low down or in the rectum proper, and then only when the opening through the growth is sufficient to allow the inverted sigmoid to be drawn through it.

There is one objection to the operation, namely, the tying of the superior hemorrhoidal artery deprives some of the pelvic tissues of nutrition to such an extent that there is a certain amount of sloughing, including the upper portion of the inverted rectum, so that the patients carry a temperature of 100° to 102° for the first week or two. This feature, however, has been serious in only one case, and that was one in which a septic phlebitis of the veins of the left leg took place, thereby delaying recovery for some weeks.

For the purpose of shortening the operation slightly, and of relieving the effects of this sloughing process, which takes place as the result of the tying of the superior hemorrhoidal at the first operation, the operation has been modified in a few minor points, and we now perform it as follows:

A large incision is made down through the inner edge of the right rectus muscle, from the umbilicus to the pubes. All of the intestines, except the sigmoid, are packed well back out of the pelvis with moist gauze. The sigmoid is mobilized by cutting the peritoneum of its mesentery on either side down to the cul-de-sac (Fig. 3), and ligating and cutting the blood-vessels of its mesentery close to the intestine. The superior hemorrhoidal is now tied and cut just below the promontory of the sacrum, where it is easily lo-

cated by its strong pulsation. A stab-wound is made through and near the outer edge of the left rectus muscle about an inch below the umbilicus. The jaws of a Payr clamp are passed through this hole, and the sigmoid seized and clamped at the desired length for the artificial anus. Anther Payr clamp is placed on the intestine just below and is applied through the main right rectus incision. The intestine is severed, with a cautery, between the two, and the clamps thoroughly heated so as to sterilize the included tissues. (Fig. 4.) The clamp, including the proximal section, is drawn out through the stab-wound, and the intestine fastened to the peritoneum, to the aponeurosis, and to the skin by chromic catgut sutures, the Payr clamp being strapped on to the abdomen and allowed to remain until such time as it is desirable to open the upper segment. A purse-string is passed around the upper end of the distal segment, the clamp removed, and the intestine inverted and fastened to the end of the rectal tube that had previously been passed up into the colon, and by which the colon is inverted and drawn out through the anus. (Fig. 5.) Two or three stitches fix and close the intussusception from the peritoneal side. The peritoneum of the cul-de-sac is drawn over the intestine and sutured. (Fig. 6.) A tube is placed in the rectum to carry off the débris of the sloughing intestine. The protruding intestine is drawn well down, and a silk-worm gut is passed through the skin about the anus and made to include the protruding intestine and also the tube. (Fig. 7.) If the patient is a woman, it is well to open the cul-de-sac and pass a tube in above the end of the invaginated intestine, but below the sutured peritoneum. (Fig. 8.)

The exudate resulting from the sloughing fat seems to create a very clear line of demarcation. In from

ten to twenty days the Kraske is done, not, however, until the temperature and pulse are normal, at which time the rectum and all of the fat tissue in the sacral cavity are removed with surprising ease, and without shock. There are practically no vessels that require ligation. The anus and anal muscles having been removed, the perineum is closed, and drainage brought out back of the original site of the anus.

I have tried other methods of doing the two-stage operation, and I feel sure that, while this operation is a little more stormy during the first stage and has a slighter longer convalescence, it is a more thorough and, at the same time, a safer operation than the other methods that have been described. I believe that, while the ligation of the superior hemorrhoidal artery produces a certain amount of sloughing, the reaction thus created is probably beneficial, rather than detrimental, from the curative standpoint.

A MANY-STAGE OPERATION FOR MAKING AND CLOSING A TEMPORARY OR THERAPEUTIC ILEOSTOMY OPENING

Dr. John Young Brown, of St. Louis, has for several years resorted to ileostomy for the treatment of ulcerative colitis resulting from various causes, and in extreme cases has used ileostomy for intestinal toxemia due to obstinate constipation, also for tuberculosis of the colon and ileum.

Since the work of Lane has been so widely published, the cause of many diseases has been attributed by some to intestinal stasis with systemic poisoning. Among these diseases may be named arthritis deformans, epilepsy, etc. Reed, of Cincinnati, has reported as cured a large number of cases of epilepsy which he has treated by colectomy. He believes that epilepsy, as a rule, is caused by an infection coming from the

large intestine. His work along this line has been quite generally condemned and discredited by conservative surgeons. Lane has convinced a great many surgeons of the desirability of colectomy in certain cases of joint trouble; and a number of prominent surgeons have reported success with these joint cases, notably Dr. Rea Smith, of Los Angeles.

Complete colectomy is a very serious operation, and is followed by very serious consequences, owing to the fact that the omentum is to a large extent removed or otherwise disturbed, and the operation is followed by extensive adhesions in many cases. So formidable is this operation, both as to its immediate and remote results, that any conservative surgeon will hesitate to do it, except for otherwise hopeless conditions. Of course, confirmed epilepsy, arthritis deformans, or other disabling joint troubles are indeed very serious conditions, and justify almost any kind of a risk if a definite assurance of cure can be offered.

The evidence of the cure of these conditions by colectomy is not conclusive, and yet so serious is the condition, in certain instances, that the patient must not be denied anything that offers rational hope of relief.

The preeminence in the surgical field of certain of the men who have given good reports along these lines is such that they must have a hearing.

While I have not been convinced that such a serious operation as colectomy is justifiable, there are certain instances in which there seems to be a very close relation between intestinal toxemia and these conditions. Such a causal relationship may be determined almost without danger by an ileostomy, which can be closed when desirable without re-opening the abdomen, and which can be made almost entirely without danger.

For the past three years, following the lead of John

Young Brown, we have occasionally performed ileostomy for the treatment of ulcerative colitis. The results have been very gratifying, but the thought of making a second abdominal operation, with a resection and anastomosis, in a patient who is otherwise well, has impressed me as being an unnecessarily serious operation for the condition. Consequently I have adopted a plan which makes both the establishment of the fistula and its subsequent closure an operation practically devoid of danger. I can, therefore, recommend the operation in the treatment of ulcerative colitis, and also as an experimental operation justifiable as a test in certain other serious conditions above referred to in extreme cases.

The operation is performed as follows: A wound about an inch and a half long is made down through the middle of the right rectus muscle about one inch below and two inches to the right of the umbilicus. The cecum is located, a loop of ileum is brought up about twelve inches from the ileocecal valve, and the two limbs of the loop are sutured together by two lines of sutures, one along their mesenteric borders (Fig. 9) and one along their free borders (Fig. 10). The loop is placed in the wound, protruding the desired distance, a fine 0-sized chromic-catgut suture is threaded into a small curved needle and is used double as a continuous button-hole suture, by which the peritoneum is sutured around the protruding loop. A similar suture is passed around the loop fastening it to the aponeurosis. A third one, threaded in a small cutting needle, fastens it to the skin. (Fig. 11.) The gas and fecal contents pass easily around this loop, so that it is not necessary to open it until convenient. (Fig. 12.) The opening is then made with a cautery, and a Delatour colostomy outfit (Fig. 13) used as a receptacle. I cannot recommend this device too highly. It has not

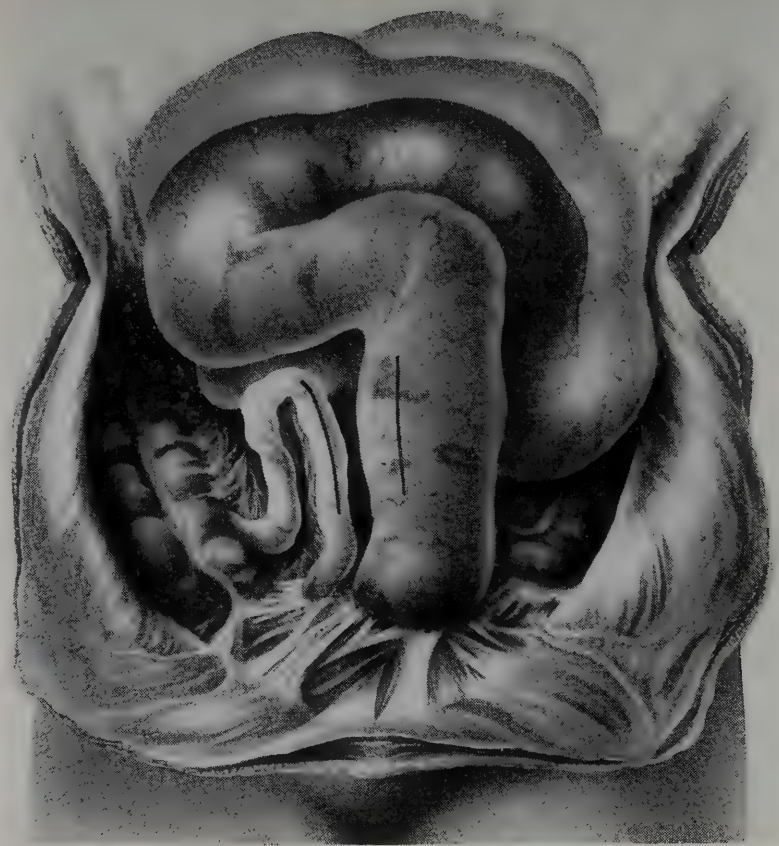

Fig. 1. Short-circuiting intestinal obstruction produced by inflammatory pelvic adhesions.

Fig. 2. Short-circuiting an acute obstruction due to carcinoma at the splenic flexure; tremendous dilation of cecum and ascending colon.

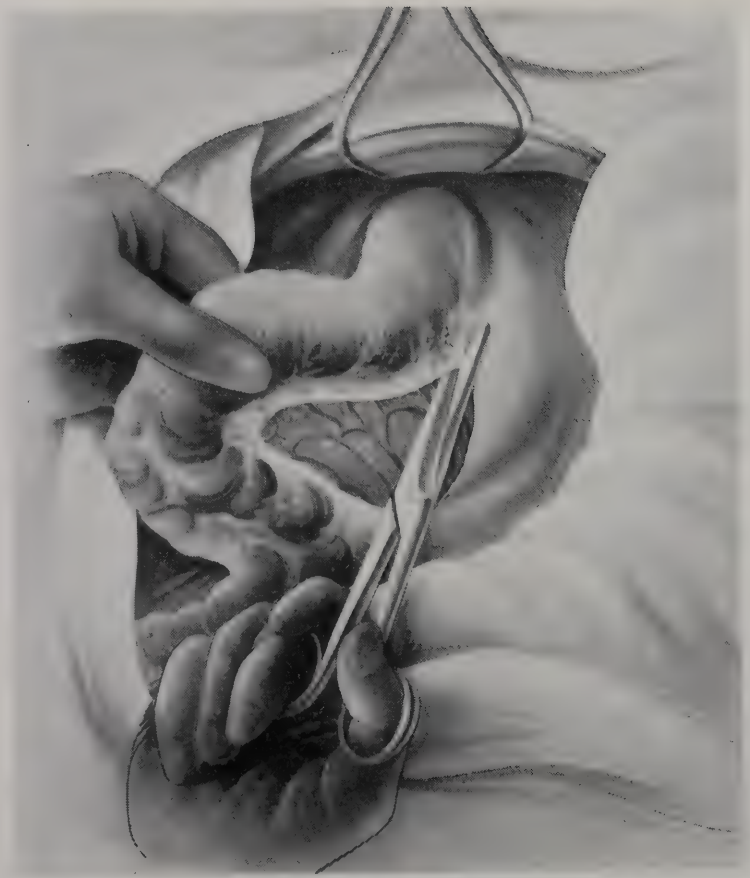

Fig. 3. Mobilizing the sigmoid by cutting the peritoneum of its mesentery, and ligating and severing the blood-vessels.

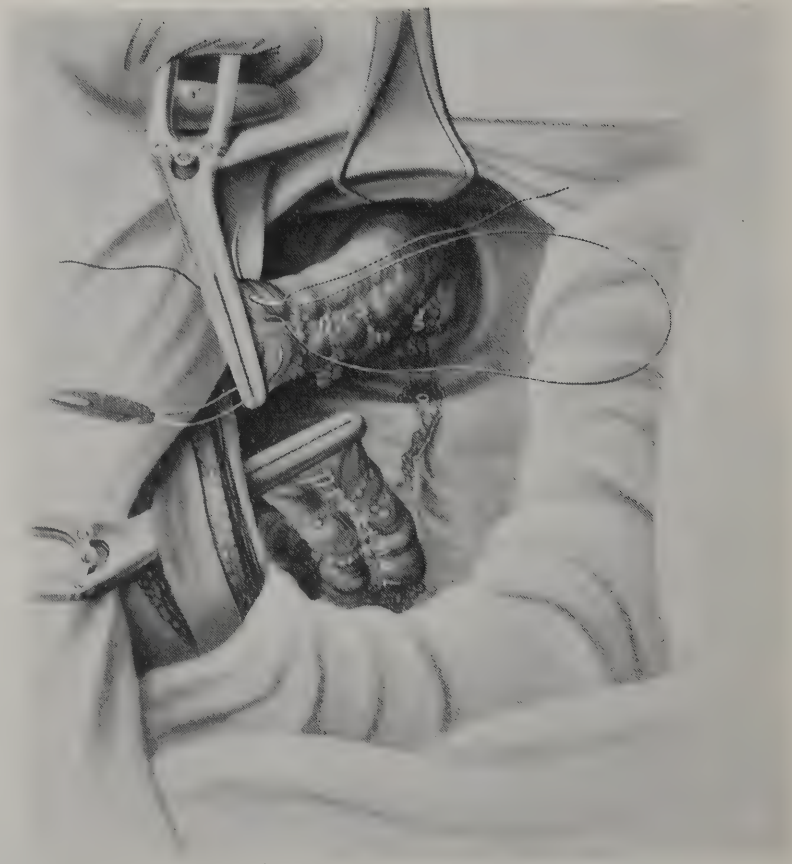

Fig. 4. Clamping and cutting the sigmoid.

Fig. 5. The intestine has been severed. The proximal end of the sigmoid in the clamp is being drawn through the left rectus incision, where it is to be sutured, and the distal segment has been closed and fastened to the end of a rectal tube by which it is to be inverted. The superior hemorrhoidal artery is tied and cut.

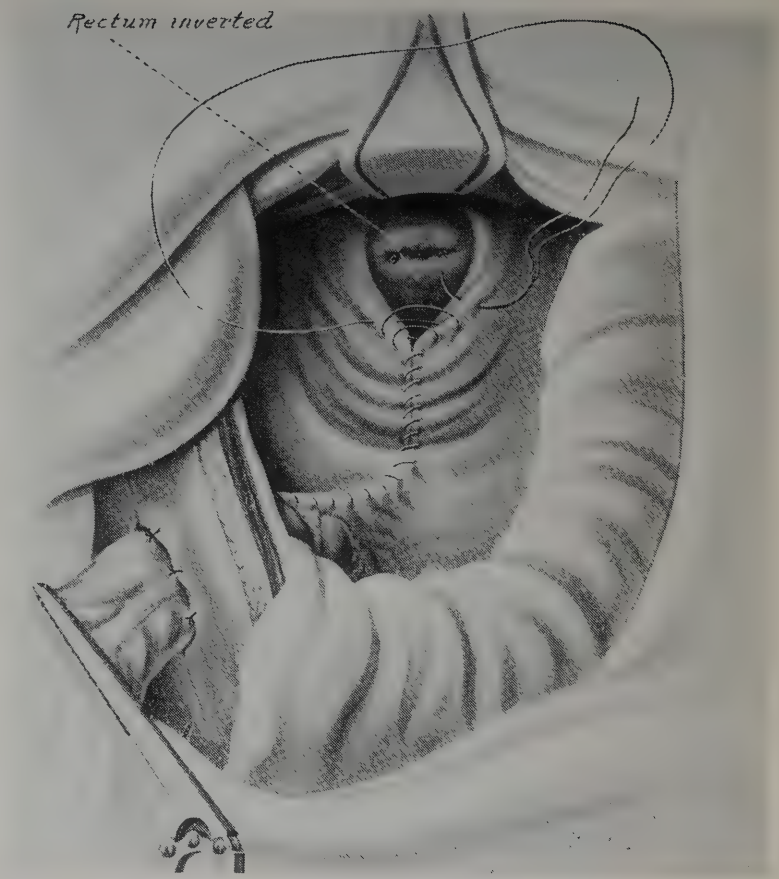

Fig. 6. The proximal segment of the sigmoid has been sutured into the left rectus incision; the intussusception of the rectum has been fixed by sutures; and the peritoneum of the cul-de-sac is being sutured over all.

Fig. 7. Diagram showing inverted sigmoid protruding through the rectum and the perforated tube in the rectum to carry off secretions and débris.

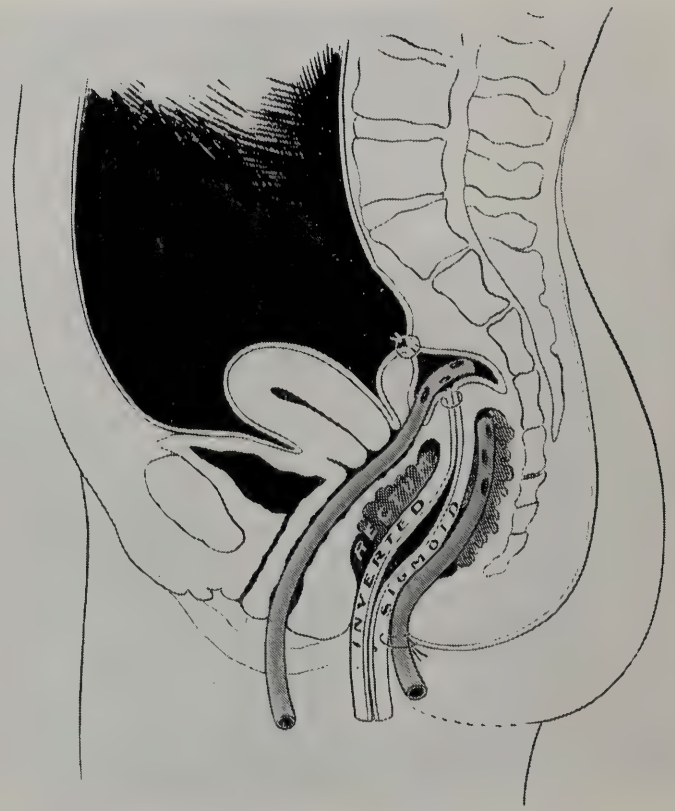

Fig. 8. Diagram showing the supplementary drain passed through a stab-wound in the cul-de-sac in case of woman.

Fig. 9. Suturing together the mesenteric edges of the intestinal loop.

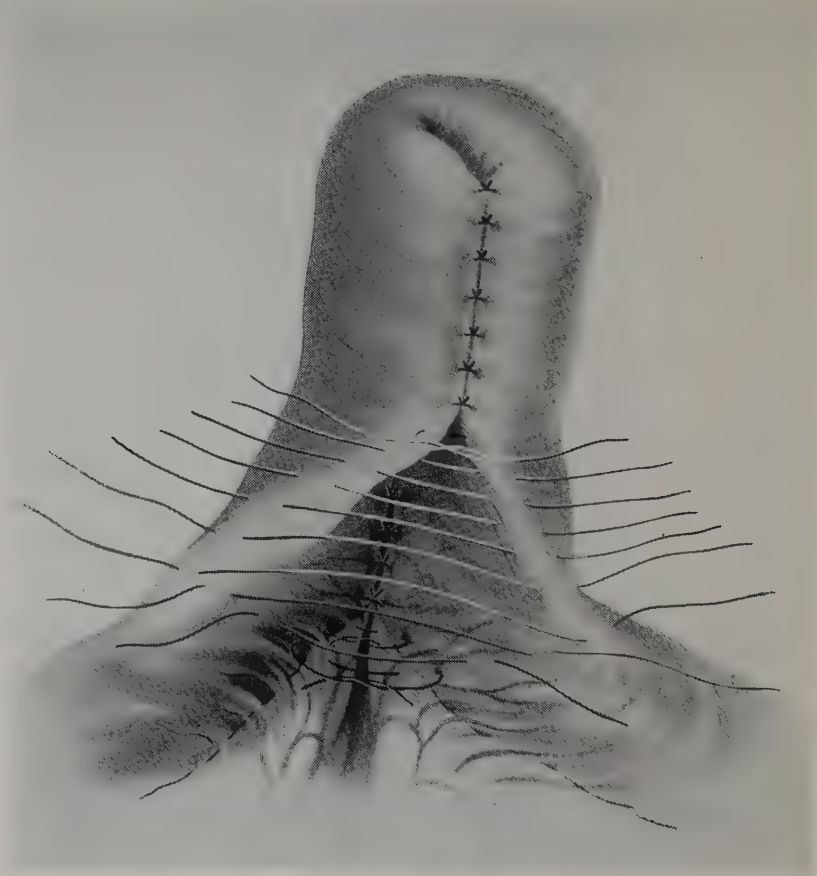

Fig. 10. Suturing together the free edges of the intestinal loop.

Fig. 11. Fixation of the intestinal loop to peritoneum, aponeurosis and skin by chromic catgut doubled. 1. Peritoneal suture. 2. Aponeurotic suture. 3. Skin suture.

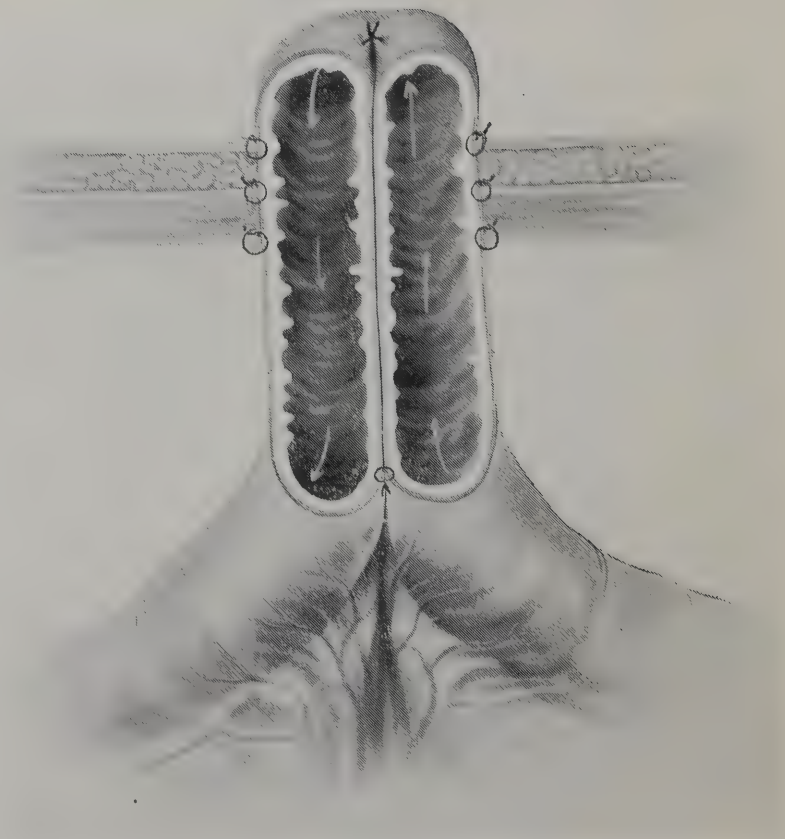

Fig. 12. Sectional view of the fixed loop showing the passage of the intestinal contents through the loop.

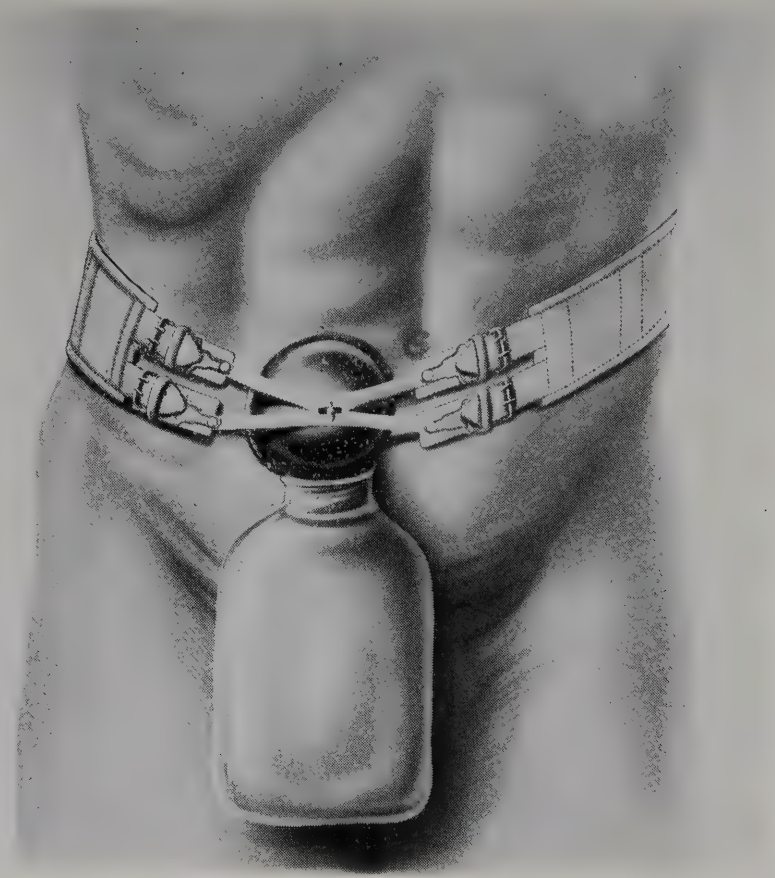

Fig. 13. Delatour colostomy bag. (Tiemann & Co. of New York.)

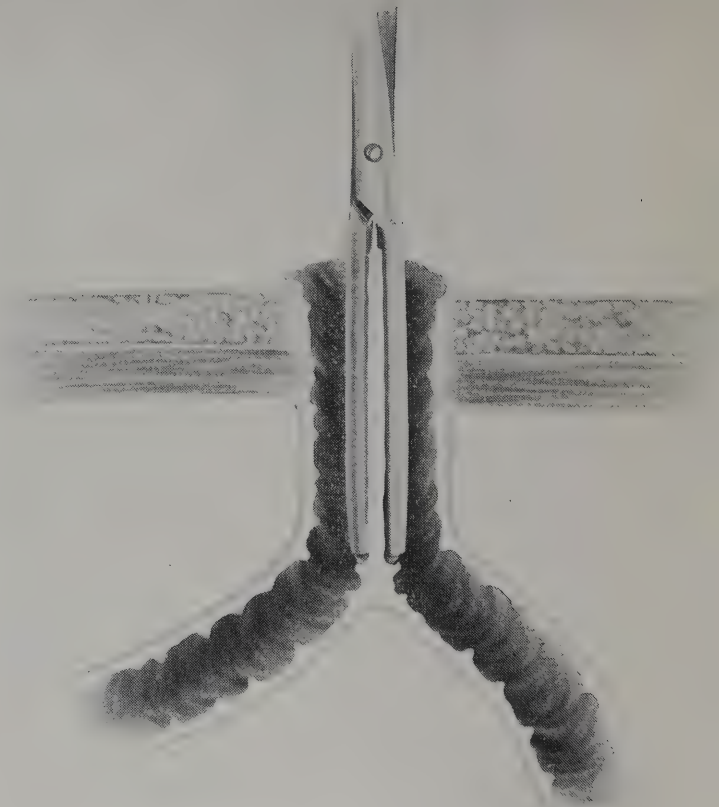

Fig. 14. Gradual destruction of the septum between two limbs of loop with rubber-covered clamp.

Fig. 15. Destruction of the intestinal mucous membrane which passes through the intestinal wall, by use of the cautery

Fig. 16. Intestinal fistula after the cauterized area has healed.

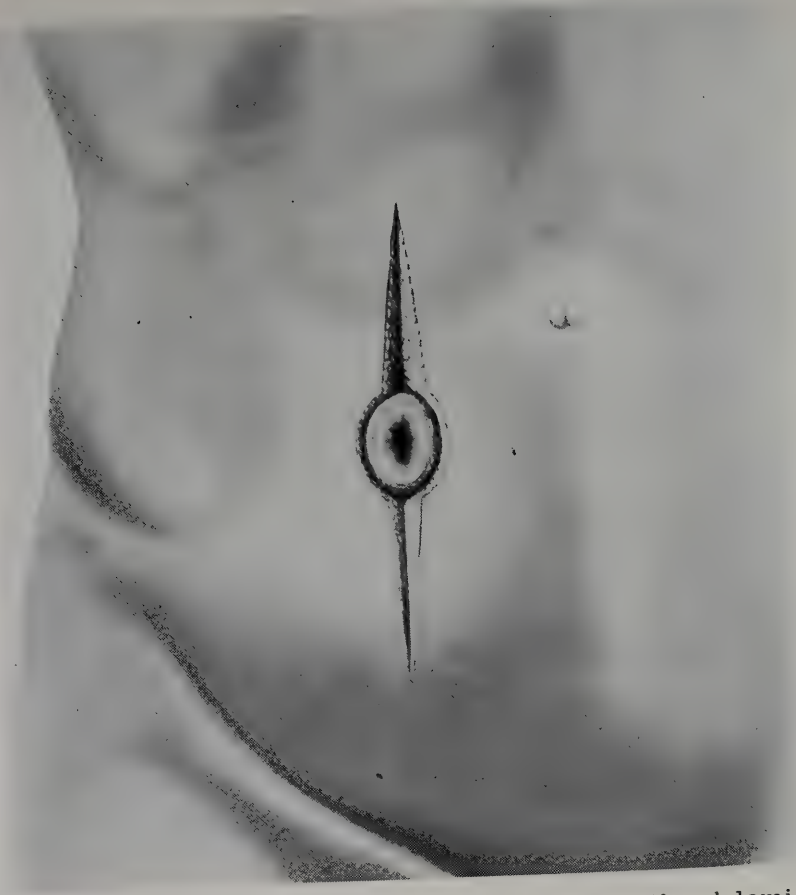

Fig. 17. Incision for freeing the fistula from the abdominal wall and separating the layers of the abdominal wall.

Fig. 18. Fistula freed, and layers of the abdominal wall separated ready for closing.

Fig. 19. Sectional view of the fistula freed, and the layers of abdominal wall separated ready for closing.

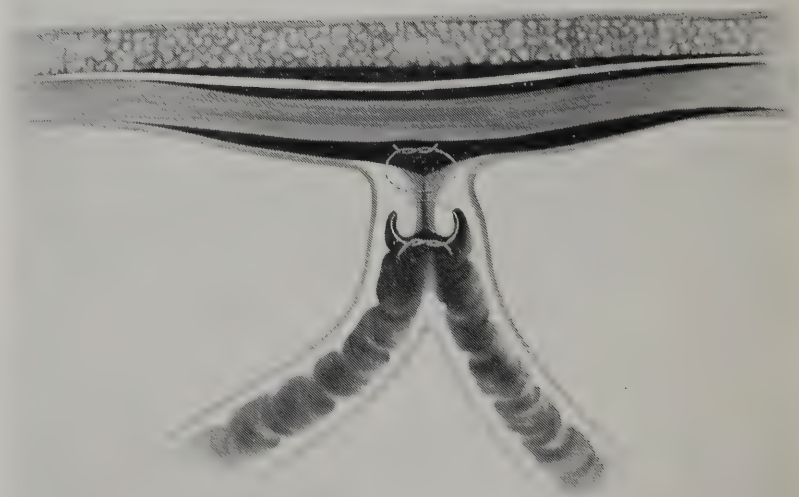

Fig. 20. Closure of the intestinal fistula.

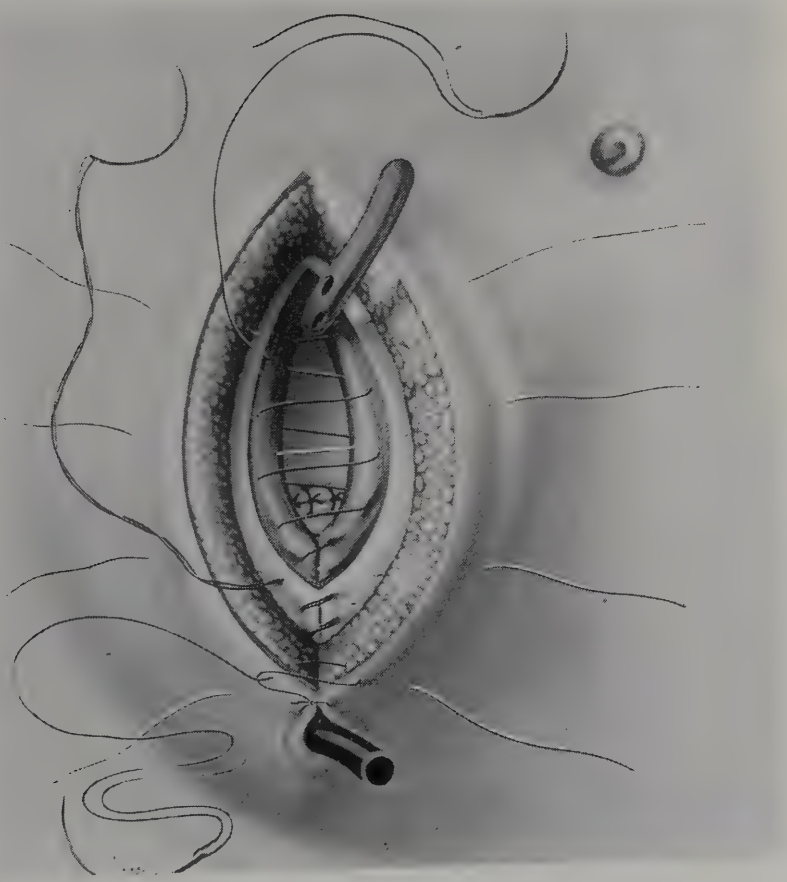

Fig. 21. Closure of the abdominal wall, showing the closed fistula in the bottom of the wound and drainage-tubes at the ends.

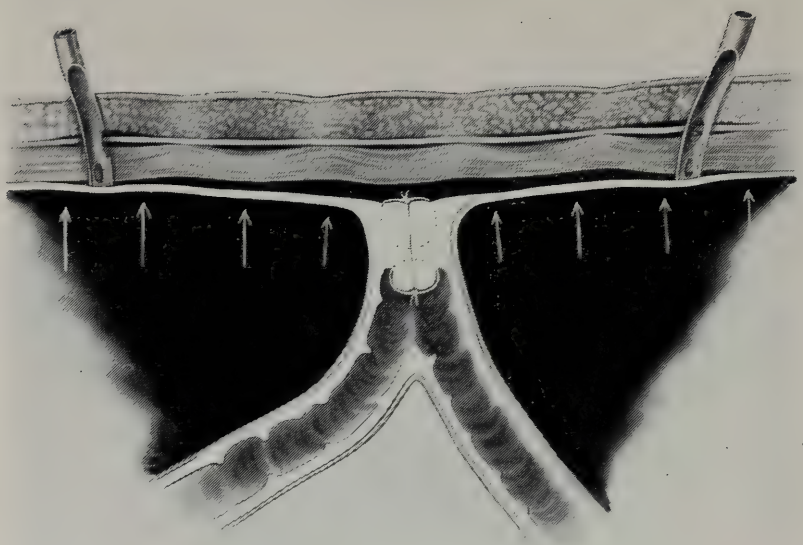

Fig. 22.—Longitudinal section of the completed operation, showing how the spaces drain around the ends to the tubes.

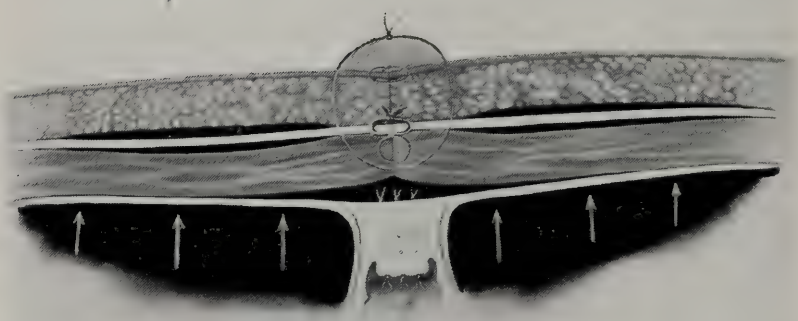

Fig. 23. Cross-section showing how all the lines of sutures are enclosed in the silk-worm sutures, which obliterate spaces and allow drainage to either side between the layers.

failed in any instance to hold, so that such a thing as spilling and soiling the clothing is unknown while the patient is standing. I have a number of such patients performing all of their duties and going to social functions as usual with no discomfort. The apparatus does not work so well when the patient is lying.

After the emergency has passed, when the colon has rested sufficiently, or the temporary obstruction is relieved, or the test as to the toxemia in question has been completed, it is a very easy matter to close the opening without opening the peritoneal cavity. This operation is done as follows:

A long, thin-bladed clamp, preferably a stomach clamp, is passed down into the two limbs of the loop, as in the Mikulicz operation. (Fig. 14.) It is even well to have them covered with rubber. In a few days, by gradually increasing the pressure, the two limbs are cut together. With a cautery the mucous membrane and intestine protruding through the abdominal wall is destroyed down well into the wall, practically to where it leaves the peritoneum. (Fig. 15.) This operation is somewhat painful, and produces a degree of nausea on account of burning the mesentery.

In a few days the patient is again allowed to be up, and again wears the Delatour bag, until the sloughing has taken place. In the meantime it is found that a portion of the intestinal contents are passing on into the large intestine, and it is gradually becoming accustomed to work again.

As soon as the wound has healed in well (Fig. 16), the fistula is closed by the method which we described in the *Annals of Surgery,* June, 1908, under the title "Remote or Indirect Subperitoneal Drainage in the Extraperitoneal Closure of Persistent Fecal Fistulæ," as follows:

1. Dissect out the old scar down to the fat, and make an incision around the fistulous tract, including a small strip of skin (Fig. 17), direct the point of the knife slightly away from the fistula so that it first comes in contact with the fascia about half an inch away from the fistula, in order to avoid any possibility of opening the peritoneum. The incision should extend two inches or more above and below the fistula to allow for wide dissection.

2. Dissect up the fat from the fascia for as much as two inches from the incision, draw it back, and clean off the fascia.

3. Make an incision through the fascia, beginning at the upper end of the wound and coming toward the fistula. Dissect the fascia from the muscle for at least two inches in every direction.

4. Dissect the muscle from the peritoneum in the same manner so that the peritoneum hangs loosely with the fistula standing up in its center, like a volcano and its crater.

5. The little margin of skin which has been left with the edge of the fistula is now trimmed off. Figs. 18 and 19.

6. If the wall of the fistula is hard and cicatricial, making it difficult to turn it in, it is well to make an incision part of the way through the cicatricial tissue so that it may be turned in easily.

7. The edges of the intestine are turned in with linen sutures which are knotted on the inside. (Fig. 20.)

8. A second layer of sutures brings the edges of this incision and the connective tissue over the peritoneum along with the scar tissue, covering the turned-in fistula, to add temporary strength and bulk to the closure. (Fig. 20.) The peritoneum and the rest of

the wound is now thoroughly mopped or irrigated with salt solution to make it as clean as possible.

9. Silkworm sutures are passed through the skin, fat, fascia, and muscle about a half inch or more from the edge, and are left untied, space being left at the upper end of the wound for drainage.

10. Suture the muscle loosely with a continuous catgut.

11. Suture the muscle with a strong double catgut.

12. Suture the skin with a horsehair button-hole stitch.

13. Place the drains, which may be tubes or cigarette drains, at each end of the wound. (Figs, 21, 22 and 23.)

We have never failed to close a fistula of either the large or the small intestine by this means when no obstruction existed below.

By this stage-operation we make of John Young Brown's ileostomy an operation practically devoid of danger.

In cases of epilepsy, arthritis deformans, etc., if the condition is relieved by the ileostomy, there is plenty of time to consider removal of the colon, which is always a very dangerous operation, if the certainty of the cure has been proved, after a duration of months or years. If these conditions are not relieved by colostomy, they certainly would not be relieved by the radical operation of colectomy. Having failed to give the relief, the continuity of the intestinal canal may be renewed by the operation just described without doing permanent damage to the patient.

DISCUSSION

Dr. Dean Lewis (Chicago): One of the characteristics of surgery in the last few years is, that more attention is being paid to the patient; and I feel this way in regard to the two-stage operation; I like to finish the operation when I can, and

have it over with. The average surgeon thinks more of himself than of the patient.

Regarding the operation of Dr. Coffey: There is no doubt that the removal of the rectum by the two-stage operation is the operation of choice for a number of reasons. In the first place, if you open the abdomen you have a chance to see what you are dealing with, whether there is an advanced pathological condition or metastasis in the liver. It has reduced the mortality enormously.

Regarding the Mikulicz operation: I think this operation was introduced not so much with a tendency to reduce the immediate mortality as to prevent late perforations of the large bowel. It is my feeling that, in dealing with large tumors of the bowel, the two-stage operation should be done. In other cases when operating for obstruction, I prefer to do resection with end-to-end anastomosis, and, if necessary, suture the anastomosis into the wound, and finish the operation at the primary step.

There is one point about ileostomy to which I desire to call attention, and that is the introduction of any consideration at all of arthritis deformans and epilepsy because of anything that has been discovered. The idea has been advanced that arthritis deformans is dependent upon a lesion, or lesions, of the large bowel, or that epilepsy may be due to the same thing. The only way to save the human family at the present time from an enormous mortality will be the introduction of some hard operation to prevent this rather than simple measures which may encourage the men who have been doing this work.

ACUTE OSTEOMYELITIS

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CINCINNATI, OHIO

Of all the surgical emergencies none is more insistent for prompt intervention than acute osteomyelitis. This disease is essentially an infection of the bone, and occurs most frequently in the long bones of the extremities of growing boys whose individual resistance has been diminished by some previous constitutional disturbance.

The onset of symptoms is sharp and decisive and is sometimes preceded by rigors or chills, although the chill may not have been noted by the little patient or his parents.

Trauma, undue exposure to cold, loss of blood, and other devitalizing processes are determining factors in ushering in an attack of osteomyelitis; and in more than 80 per cent of the cases the staphylococcus aureus has been found to be the specific cause of the disease. In the more virulent type of the disease streptococci will be found; occasionally the bacillus pneumococcus, bacillus coli, and bacillus typhosus have been present as causative factors in the production of osteomyelitis.

The shafts of the femur and the tibia are favorite sites, and the disease is said to begin, in the greater number of instances, near the epiphyseal line, and may, if not recognized and properly managed, perforate into the neighboring joint. Although the disease attacks the shaft of the long bones by predilection, no

bone in the body is secure against the invasion of pus-formers. Involvement of the distal phalanx of the index finger, constituting the ordinary "Whitlow," is a familiar and not infrequent example of osteomyelitis. In no instance in the writer's experience has more than one bone been involved, but cases are recorded in the literature wherein a number of bones became affected simultaneously. It has been suggested that the so-called "growing pains" of infancy are mild expressions of this disease, but, in far the greater number of cases, the process will be of the fulminating type in the beginning; however, it may become quiescent, and all symptoms disappear for a time, only to recur and rapidly complete the destruction of the infected bone. Spontaneous resolution is said occasionally to occur, but it is so infrequent as to constitute a clinical curiosity in bone-pathology. The far-reaching influence of the destruction or separation of the epiphyses, in growing bone, is apparent in the various deformities, pathological fractures, or complete arrest in development, which one constantly meets in neglected cases of this disease.

While the addition of trauma following exposure to cold and other enervating processes, has been held to be the determining factor in localizing the focus in bone-infection, it is highly probable that terminal arteries found in the end of the shaft will more rationally account for the frequency with which abcess-formation is found near the epiphysis of long bones. The writer has observed in three separate instances an acute osteomyelitis located in the lower end of the shaft of the left femur in patients suffering from neglected mastoiditis; the patients were all adults and all three died. The occurrence may have been a mere coincidence, and is presented merely as a clinical observation.

Infection of the medulla may be likened to an intracranial hemorrhage; in either instance the far-reaching destructive influence is out of all proportion to the local conditions.

A similar infection taking place in the soft structures, other than the sole of the foot or palm of the hand, would perhaps not have come to abscess in a patient in fair health; and the loss of an equal amount of blood outside the skull would scarcely have caused an increase in the pulse-rate beyond a few short hours; and still there will follow untold suffering, wide destruction of bone and soft structures, loss of limb or life in one instance, and unconsciousness, paralysis, or death in the other.

This, gentlemen, introduces the subject of the mechanics of osteomyelitis, a clear conception of which is absolutely essential to comprehension of the fundamental principles underlying the pathology and management of this disease.

Pus in the medullary portion of the bone tends to rapid invasion and destruction along lines of least resistance. By spreading upwards and downwards the entire medulla is soon destroyed; the disease may tunnel through the articular surface and invade the joint; or, by way of the Haversian canals, it may invade and destroy the cancellous tissue, after which the pus is held in leash for a time by the periosteum, which in turn is detached from the bone, permitting the accumulation of a quantity of pus between the denuded bone and its periosteum. The amount of pus and the extent of bone-destruction will depend upon two factors,—namely, the virulence of the infection and the resistance of the periosteum. When the periosteum yields and perforation takes place, wide destruction of fat and fascia quickly follows, and in a very short space of time we may observe an enormous accumu-

lation of pus, coursing through which are seen the unsupported blood-vessels and nerves.

Here we come to a parting of the ways. The writer has endeavored to describe that which he has seen clinically, time and time again, but in no instance had the skin given way; although months had elapsed, and the skin covering the accumulation of pus was thin, shining, and drawn taut like a drum-head, still it was intact.

Can it be that the pressure which was so essential to forging the foregoing links in this pathological chain is wanting? Has the virulence spent its force or has nature won the battle for supremacy?

The shaft of the bone under such circumstances is almost wholly deprived of its internal blood supply and of the protecting influence of the periosteum, a condition which might have been easily averted by early recognition of the disease and prompt intervention on the part of the surgeon.

Our grandfathers in surgery knew how to save the distal phalanx of a patient suffering with Whitlow by early free incision, but for some unknown reason they left the further application of this cardinal principle in the treatment of acute osteomyelitis to those who were to follow them, as witness the numerous specimens in museums of sequestra comprising the entire shaft of long bones minus epiphyses and periosteum.

An infected umbilical cord stump in the very young should put one on guard for this disease; if the infant suddenly develops constitutional symptoms associated with swelling, local tenderness, and disinclination to move the limb, one should suspect a beginning osteomyelitis. At this early period infantile paralysis must be ruled out, but the abrupt onset, edema of the overlying structures, and local tenderness or severe

pain elicited by palpation, are of cardinal value in the differential diagnosis if death by septicemia does not occur before the disease becomes fully established.

In looking over my clinical records I find that a large percentage of these patients whom I have seen in consultation have been suspected of suffering from typhoid fever; indeed, the early manifestations of the two conditions (osteomyelitis and typhoid fever) are very confusing to the examiner in the typical case. One should neither wonder nor be chagrined at such errors, when he recalls, as pointed out in an earlier page of this paper, that the bacillus typhosus is sometimes found as a causative factor in the production of bone-lesion, or that two morbid processes may coëxist, one being but a complication of the other.

It is highly probable that bone complications occur during the course of typhoid infection much more frequently than has hitherto been believed. A point in instance of this was found in the case of a patient suffering from typhoid in whom perforation was supposed to have taken place on or near the twentieth day of the disease. Intense pain of a boring character which extended to the dorsal spine was the chief objective symptom. There was no change in the temperature or the general contour of the abdomen, but the pulse-rate had increased notably. Something had gone radically wrong in a patient already desperately ill. With but two of the ear-marks of perforation of the intestine, sharp pain, and increased frequency in the pulse-rate, to guide us, I concurred in the diagnosis, and advised immediate operation, which was not accepted by the husband on the ground that the patient was too weak. Autopsy held about two weeks later failed to reveal a perforation of the intestine. A partially broken-down eleventh dorsal vertebra accounted for the pain from which the patient

suffered, and for the error in the diagnosis of the complication.

Pain in the joints and bones accompanying or preceding eruptive fevers and meningitis are to be differentiated from osteomyelitis by the early development of other characteristic symptoms of the acute exanthemata. A point with excessive tenderness in some part of the shaft of the bone distinguishes this condition from the arthritides; another aid to diagnosis lies in the fact that the swelling which is caused by osteomyelitis appears on the second or third day of the disease, but the swelling in joint affections comes on early and may appear as the first symptom which attracts the parents' attention.

The disease, ordinarily speaking, runs a very acute course; recognition, however, of the chronic forms of osteomyelitis is highly essential to a clear conception of end-results following fracture of the bone, for patients thus afflicted prior to fracture are prone to show bony deformity, delayed union, non-union, angulation, coxa vara, or overgrowth, due to chronic osteomyelitis, and may cause the jury to decide adversely in a case wherein a splendid functional result has been obtained if the antecedent conditions are taken into account.

This is a strong point in favor of taking a careful history of the patient, and insisting upon checking up the result after reduction of the misplaced fragments in all fracture cases.

I cannot here enter into a discussion of the finer subdivisions of osteomyelitis other than to mention borderline cases of severe periostitis induced by lues, gonorrhea, and allied conditions, which sometimes involve the bone superficially. The calcaneum is a favorite site for this type of infection; and, in event of pain induced by pressure over this bone, one should

institute an investigation anent the sanitary condition of the Shrine of Venus.

Tuberculosis is by far the most important and a very frequent bone-infection; insidious of onset and showing a predilection for epiphyses, in young subjects it may continue for months unrecognized, to the ultimate disorganization of the joint.

Trauma is a determining factor, but the history of an injury is often wanting owing to the frequency with which youngsters injure themselves and the fact that lasting impressions of such incidents are rarely retained. Nocturnal outcry, and pain aggravated by use or passive motion during an examination, are characteristic of this form of disease. The spindle-shaped swellings of long bones and of bones of the hands and feet, painless in origin and tending to sinus-formation and the discharging of thick caseous pus, are, for the greater number, tuberculous in origin.

I have dwelt at length upon the necessity for prompt, accurate diagnosis. The treatment is essentially surgical, and any delay in the recognition will prove disastrous and may cost the life of the patient. There is something pathetic in the story of the fever-chart usually found in chapters dealing with osteomyelitis.

With every chapter of the clinical story complete ere the thermometer was placed in the mouth of the pain-racked, septic little patient, a misguided nurse, at the direction of her staff, is found assiduously recording hourly temperature, applying hot fomentations, and otherwise as hopelessly engaged as though inveighing against the earthquake's shock or the blast of a hurricane.

The physical findings are accurately recorded from day to day as the temperature-curve drags its weary length until perforation or death relieves the terrible suffering.

Unfortunate, indeed, is the student of pathology who never sat at the feet of the late senior surgeon at Mercy Hospital, and witnessed the dramatic attitude and tragic speech of this unexcelled master in the art of surgical technic and surgical pathology while he was discussing the treatment of acute osteomyelitis.

"Take a gimlet, take a nail, take anything which will make a hole in a bone, and let the pus out."

This, gentlemen, embodies the fundamental principle in the management of acute osteomyelitis, and it will become effective in inverse ratio to the time that has elapsed between the onset of the symptoms and the application of this remedial measure.

Quinine, opium, castor oil, serum, and supportive treatment in the post-operative care of these patients will be found highly beneficial to a rapid and complete convalescence.

A discussion of the removal of sequestra, introduction of "bone-wax," bone-grafts, and other technical points in the management of chronic osteomyelitis would carry us far afield at this time; furthermore, if you will follow the suggestions herein laid down, such topics will lose much of their present interest if the patient applies for advice ere irreparable damage has taken place.

FOR DISCUSSION SEE PAGE 186

SKIN-FLAP IMPLANTATION AS A RADICAL MEASURE TO CURE OLD SUPPURATIVE LUNG-ABSCESSES AND EMPYEMA ABSCESSES

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The presentation of this subject at this time does not demonstrate a perfect method of obliterating lung-abscess cavities and old empyemata, but, rather, illustrates the gradual improvement in the technic, which may eventually lead to an efficient and practical method of curing a condition of the lung which heretofore has been one of the most difficult tasks for the surgeon. Surgeons who have had experience with this class of cases know only too well the difficulties which one encounters when he tries to obliterate an empyema or lung-abscess which has not closed spontaneously after a reasonable length of time.

I shall not discuss here the various methods and the surgical technic which are employed in draining acute lung-abscesses or empyemata, but will simply speak of the treatment of the cases which already have been operated on in the acute stages and have failed to close.

We ask ourselves the question why it is that most of the cases heal spontaneously after the abscess or empyema has been drained, and others keep on draining despite every effort on our part to close them. A

lung-abscess is more likely to persist than an empyema, because the abscess wall is more rigid after it has persisted for a long period. In empyema it will depend entirely upon the resiliency of the contracted lung. If the empyema has persisted for many years, the lung will be contracted to a small mass of connective tissue in the upper posterior part of the thorax, and will leave a large space between the rigid chest-wall and the remnant of the lung tissue.

These cavities are difficult to disinfect, because a good many of them communicate with one or more bronchi, and in others the pleura contains living micro-örganisms, even if the secretions appear sterile.

Chronic suppuration will also be greatly influenced by the operative treatment which has been done in the first place, the drainage-tube at times being placed entirely too high for efficient drainage, and thus there is a constant accumulation of pus. At times, foreign bodies will be found, such as rubber drainage-tubes, which have slipped in, and in lung abscesses we find concretions of lime salts, which keep up the suppuration.

Cases that hold a quart or two will rarely obliterate spontaneously. Nature tries its utmost to contract such cavities; the ribs have retracted until they are close together, forming practically a solid bony chest-wall with the intercostal spaces entirely shut, in fact, in many cases they overlap; the diaphragm has pulled up two or three inches higher on the affected side, so that sometimes the dome reaches to the third or fourth rib; even the spine will curve to the affected side, to diminish the size of the cavity. These efforts of nature to eliminate the cavity are further aided by granulations of the pleura, which grow profusely to fill the rest of the empty space. After all this, we find cases which after years hold as much as 1,000 c.c. of fluid.

Surgeons have taxed their ingenuity to cope with this extremely difficult situation. They have devised operations for the obliteration of these suppurating cavities. Those best known are the Estlander and Schede operations, the decortication of the lung, and the extrapleural resection of the ribs for the collapse of the soft parts.

In 1908 I described a method of obliterating empyemata and lung-abscesses by means of injecting a mixture of bismuth subnitrate and vaseline, in proportion of one-third of the former to two-thirds of the latter, commonly known as bismuth paste, which has been found quite efficient in obliterating the majority of these protracted suppurating sinuses in empyemata. The literature contains so many favorable reports on this treatment that I do not need to mention my own experience in this class of cases, except by stating that in cavities holding not more than six ounces of fluid, the treatment by bismuth injections will be found extremely valuable, and that nearly every case with a small cavity can be obliterated by this treatment. There will remain, however, a residue of cases where the cavity is too large, and, although it may become sterile, the rigid chest-wall is unable to meet the firmly retracted lung, and thus the free space will remain. For this class of cases I have devised a method of closure which is based on the principle employed in cavities of bone-lesions, such as osteomyelitis,—namely, implanting skin into the depth of the cavity, in order to stop the suppuration. In other words, the interior of the cavity is transformed into skin-covered surface, and I shall show some of the earliest cases in which I have performed this operation, and although, in the first few, it has not proved entirely perfect, there is a prospect of perfecting the technic to such degree

as to make this procedure supplant all the extensive resections of the chest.

I shall now show several cases to illustrate the method and the points of technic will suggest themselves during the demonstration. I shall also show on the screen some of the features connected with the work.

I cite here in detail only one case and illustrate the same with pictures. I shall reserve for a later period the publication of the other seven cases of which I have records, when the permanency of the cure is established and when more material has been added to it.

CAUTERIZATION OF BRONCHUS AND IMPLANTATION OF SKIN-FLAP AS A MEANS OF TREATMENT OF BRONCHIAL FISTULA

A girl, aged 19, developed a lung-abscess at the age of five, which was drained in the axillary line, in the region of the fifth rib. Constant discharge for fourteen years with expectoration of pus, was the deciding factor for this extensive operation. A flap including skin, fascia, and muscle, eight inches in length, with the base toward the axilla and the apex pointing downwards, was raised, and the ribs exposed. Two sections of the fourth and fifth ribs were removed. This laid open a small abscess cavity, so narrow as to be considered a portion of the bronchial fistula. The walls of the abscess cavity were smooth and glistening, and in this respect different from the mucus-lined bronchial opening.

DESTROYING THE MUCOUS MEMBRANE BY CAUTERY

The abscess cavity was explored with the finger, no foreign body was found, but on inspection the opening into a large bronchus was visible. The actual cautery was employed in this case to destroy the mucous membrane in the large bronchus, and thus insure complete obliteration of the opening. In order to prevent a fire, the ether anesthesia was discontinued, and for about three minutes the patient was given oxygen by inhalation, to get rid of all the ether in the bronchi. The mucous membrane was destroyed, the Percy cautery being employed. This step is illustrated here.

In some instances the abscess cavity consists of compart-

Fig. 1. Cauterization of the bronchial fistula after exposure of lung abscess.

Fig. 2. Implantation of skin-flap; gauze packed against flap.

Fig. 3. Complete closure and skin-evolution. After sixteen years of suppuration.

ments which are divided by distinct septa, and in each of these compartments is a small bronchial opening. In one of my cases seven such bronchial openings opened in the abscess cavity.

GAUZE TIGHTLY PACKED AGAINST INSERTED FLAP

The apex of the skin-flap was now grasped with artery forceps, and drawn directly into the cauterized bronchial opening, to plug it and to produce union of the raw surface of the skin-flap with the wound surface. No sutures were applied to the skin, neither to the external wound, nor to the flap, but gauze was tightly packed against the inserted flap to produce rapid adhesion.

Should it be difficult to retain the skin-flap by a mere packing of gauze against it, it may be feasible to anchor the end of the flap into the deepest part of the cavity. Care, however, must be taken not to puncture any blood-vessels.

Firm adhesions of the skin-flap usually take place in four or five days.

THE RESULT OF THE TREATMENT

The further treatment in the case consisted in the adhesive plaster method of epidermization of the raw surfaces and daily dressings until the entire cavity had been covered with epithelial growth.

The discharge and cough stopped a few days following the operation and the patient gained weight. The final result is in the accompanying illustration.

Bronchial fistulæ are not always single, although they may empty into one cavity, and communicate with the outside by a single sinus of the chest-wall. I demonstrated by one case presented, in 1915, before the Western Surgical Association, an abscess cavity which contained seven separate bronchial openings. These were cauterized with a nasal cautery under light reflected from a head-mirror. The procedure was entirely painless, and caused no other discomfort than the irritation produced by the smoke of burning flesh drawn into the trachea and nostril during inspiration.

The method has these five objects in view:

1. To expose the diseased area by an adequate flap-incision.

2. To take away every vestige of the diseased tissues under the guidance of the eye.

3. To close the wound in such a way as not to permit any dead space in the resected cavity, implant the skin-flap.

4. To use no suture material whatever, except ligatures for arteries, and leave the wounds widely gaping.

5. To reproduce epithelium of granulating surfaces with skin-grafts.

DISCUSSION ON THE TWO PRECEDING PAPERS

Dr. A. R. Colvin (St. Paul): Dr. Haines has emphasized sufficiently the necessity of two things in osteomyelitis: first of all, recognition of the disease, and then the early attack. The following case illustrates the variability of the clinical manifestations of osteomyelitis: A child suddenly becomes ill, with fever, delirium, and a retracted head. A diagnosis of meningitis is made because of the retraction of the head. After the sudsidence of the acute general symptoms an enlargement of the tibia is noticed, although the child feels well and is running about. In the course of two months, as the child complains of pain in the leg, an *x*-ray picture of the tibia is taken, and the entire interior of the tibia is found to have been destroyed, as shown by the *x*-ray picture. After a year the entire tibia has regenerated without the establishment of even a sinus externally. At the end of more than a year one focus at the lower end of the tibia has not cleared up, and is beginning to cause ankle-joint symptoms, and has to be opened.

This, of course, is a very great contrast to the other acute forms where the bone is destroyed in a comparatively short time. It is only by studying the chronic forms that we are able to treat the later stages of the acute forms intelligently.

The other point which I think must be emphasized is the study of the vascular supply of the bones by Lexer in relation to the usual sites of initial infection. I do not know of anything that has been so helpful in cases of subacute osteomeylitis as the work of Lexer in demonstrating just where the osteomyelitic process usually begins. I recall one case which illustrated proper recognition of the value of this work. The patient had elevated temperature with delirium and very slight swelling of one knee-joint. Some tenderness was elicited over the front of the tibia in the metaphyseal region. Under local anesthesia an incision was made through the

periosteum at this point, and a few drops of pus escaped. One could see pus oozing through the vascular canals in the bone, and on opening through the compact tissue a localized suppuration of the medulla was discovered. In three days a similar opening through the periosteum of the opposite tibia failed to find pus, but on opening the cortex only a few drops escaped. If we examine these patients early, remembering where the osteomyelitic process begins, where the infection has taken place, we will very often save the patient a very large and extensive operation of opening up the whole bone when the whole bone is not infected.

The other point in regard to the localization is that these infections are always in the shaft of the bones: they are not in the epiphysis. The old term "epiphysitis" was a misnomer. The epiphysis may be infected with any organism, but probably in 99 cases out of 100 the infection is in the metaphyseal line or distally, as the case may be. The metaphysis is not as a rule within the grasp of the capsular attachment, and infection in the metaphyseal region consequently does not cause suppuration in the joint. In diseases of the shaft (the metaphysis) the joint is practically never infected unless in badly neglected cases. There is an exudate in the joint; and there may be a great deal of serum so that the joint is acutely swollen; but rarely is there any pus in the early stages. One exception to this, however, is the upper end of the femur; the hip-joint is the only joint in the body in which the diaphysis is practically included in the grasp of the capsule. In osteomyelitis of the upper end of the femur, consequently, infection of the joint is early and common.

Dr. Byron B. Davis (Omaha): I suppose the more closely the advice of Dr. Haines is followed in the treatment of the acute form of osteomyelitis the fewer will be the number of very bad cases, such as have been demonstrated by Dr. Beck. I have always felt that most of these exceedingly bad cases, which last year after year and have many operations done without success, are due to more or less dilatory tactics at the beginning. This, of course, is not always the case, but very frequently so.

In these chronic cases of osteomyelitis, where we have long-continued trouble, sinuses running year after year, it is exceedingly important to know how much bone is diseased, and, fortunately, the *x*-ray helps us out. If we find that the disease is rather sharply localized, if we do not have a very

large sequestrum there, I have always been very much in favor of a minor operation, and, preferably, the use of bismuth paste in these cases; but Dr. Beck has touched upon a class of cases that cannot be relieved by any of these ordinary measures. If we have extensive trouble in one of the serious cases, with probably a lot of eburnation of bone, we have a large operation to do; and one thing I want to know positively before beginning is something about the resisting power of the patient. I have seen one or two patients die from these operations where an amyloid condition of the viscera already existed, and it was only to be expected that a fatal result would follow. I want to warn you to look after the general condition of the patient very carefully before you begin, and when you begin, I believe, like Dr. Beck, you should be absolutely radical—make such a large incision that you can inspect every part and remove all disease with one fell swoop.

The particular point of Dr. Beck's paper in leaving open wounds, it seems to me, is just the thing; and when he emphasizes using absolutely no sutures, I believe he has emphasized a point that is very important. I know the tendency is for all of us not to leave too much of a wound. We think that a suture or two will improve the condition, and then we will probably pass another suture about the other end. We narrow the thing down, and we do not get the good drainage we ought to have. In addition to all the other advantages of Dr. Beck's operation of leaving the skin wound wide open, we leave opportunity for epidermization, and we get a covering there which we would not otherwise get, and could not get, unless we leave the wound open as he does.

I wish, in conclusion, to compliment Dr. Beck on the splendid results he has obtained in these three very bad cases.

Dr. J. D. Griffith (Kansas City): I want to say a word or two on Dr. Haines' excellent paper on osteomyelitis. I think it is exceedingly important for us to differentiate as soon as possible between osteomyelitis and typhoid fever to which he referred. I think there is the place where we can call in our laboratory, and do very efficient work. Typhoid fever comes with an up-and-down temperature, morning and evening. It does not give any marked leukocytosis, and no marked polynuclear increase in percentage; but you cannot find a case of acute osteomyelitis without both of these being markedly increased. It matters not whether it is due to

staphylococcus, streptococcus, the typhoid bacillus, or otherwise, it should be one of the guides. I do not care how sick a child is, nor how delirious the child is, the member that is involved in the osteomyelitis is absolutely useless, whereas the child will use the other one in its delirium. The swelling of osteomyelitis is painful on account of the bone casing around the cancellated structure where the germ has found mural implantation. On account of a slight cold being an exciting cause, we have a point that is more sensitive under delirium along the line of that bone than at any other point, and, if we are active in going in on that bone, we need fear no danger if the polymorphonuclears are up above 80 per cent, where you will find them ninety-nine times out of a hundred.

With regard to Dr. Beck's paper: I want to thank him for the introduction of that epithelium into the bottom of the place that he has cleaned out. This helps to solve the mystery of those old cases in which healing would not take place. In the case of the man where a bronchial tube was opened, the old treatment of going in and doing extensive rib resection and getting down there with the Schede operation, would have given him very marked scoliosis, but he has very little scoliosis. He will go through life almost straight. If you examine him closely you will find there is resistance in his spine, but it is so slight that it cannot be observed.

I wish to congratulate Dr. Beck on his excellent paper and on the results he has achieved in these cases.

Dr. H. E. Pearse (Kansas City): I think the more we study the bacterial infections in bone, the more apt we are to get away from the theory that the bone manifestation is primary. In other words, hematogenous infection does not take place until the tissues of the body are widely infected; and the only reason osteomyelitis requires special treatment is because of the terminal results in the bone and because of the inability of the bone to take care of itself.

Recently, there came to me a boy with a swollen right limb, and a fluctuating knee-joint, with a temperature of 106°, with delirium, and with a history of a long course of boils upon his body. There was one slight abscess on the opposite shoulder at the time. The internes on the service were rather doubtful about the pathological conditions. One of them insisted that the patient was suffering from an acute osteomyelitis; another one said he had secondary arthritis of the knee-

joint secondary to the long boil formation; and a third insisted that on account of the boy having a red spot upon the external portion of the knee-joint we had erysipelas to deal with, and in consequence of that idea they took a culture from the boil on the shoulder. Immediately following that we prepared to open the bone, because I was satisfied of the presence of an acute suppurative osteomyelitis of the shaft of the femur. After the primary incision was made through the skin, the edematous tissue lying beneath the skin was immediately cultured into several tubes. After cutting through the soft parts, I struck the chisel through the bone and found no pus, but with the end of the bone-scoop I went deeply into the medullary cavity of the bone, and carefully cultured the substance taken from the center of the bone. I gave up my diagnosis of suppurative osteomyelitis, and one interne gave up his of erysipelas, and agreed we had a secondary knee-joint infection. I opened the knee-joint, removed several ounces of turbid fluid, which was not pus, and this was placed in culture tubes. All of the cultures showed a virulent streptococcus except the one cultured from the boil upon his shoulder, which grew to be a rather innocent staphylococcus albus. We covered the wounds, let them alone without drainage or further interference, and the man made a good recovery, with perfect restoration of function of the limb. We must recognize that hematogenous infection is general, and that the infection in the bone is only on account of the limited ability of the bone to take care of itself.

I wish to congratulate Dr. Beck upon his fastening skin into these deep wounds. I tried to do this a few years ago by turning the edges of the skin, and holding them down with iron nails, and we did not get anywhere. The reason of Dr. Beck's success is the very large and long skin flap which he uses and allowing the flap to press to the deepest portion of the wound without tension. I am very glad to have seen the technic of the doctor.

Dr. D. W. Basham (Wichita, Kan.): The transplantation of skin in the bottom of the wound in the treatment of osteomyelitis is a most excellent thing, but I do not think we should allow it to pass as something new. If you will turn back, and consult your old books of twenty-five years ago, you will find the operation very well described; I did it myself very nearly twenty years ago.

Dr. F. T. Murphy (St. Louis): Dr. Haines has emphasized the point that osteomyelitis begins in the medullary cavity. One point I would take exception to is, that we should use a nail or a gimlet with which to make a hole to relieve tension within the medullary canal in cases of osteomyelitis. It is better to take a chisel, and take the top off. It is difficult, if not impossible, to drain osteomyelitic processes through a small gimlet opening.

Another point in which my experience has been rather different from that of Dr. Haines is as to whether there are multiple or single infections. If I understood Dr. Haines correctly, he said that in children particularly they were usually single. I may have misunderstood him in that regard. In a considerable series of cases which we have had the infections have been multiple, rather than single.

Another point which has interested us, and which we have not been able to follow to any conclusion, is the selective action of these organisms when injected from cases of osteomyelitis. From a limited number of experiments it would seem as if these organisms have a selective action for bone.

In Dr. Beck's paper I think we have all been impressed by the results he has obtained, and, personally, it seems to me, the use of skin flaps and the removal of dead bone, is to be enthusiastically advocated. In my own mind I was a little confused as to how much emphasis Dr. Beck would place upon the use of bismuth-paste injections. I think the statement was made in the first part of his paper that some 40 or 60 per cent of the total cases were cured by the injection of bismuth paste. In my own experience that has not been the case. If I understood Dr. Beck correctly, I would congratutate him very heartily upon the results; but I would have to confess that personally I have not been able to get them, and it seems to me that the injection of this paste into sinuses is a different thing from filling an open cavity with Beck's paste or with the Moorhof bone-wax, especially putting it into a tortuous sinus. To put it into the latter is to introduce there a dangerous principle in the surgery of bone.

Dr. J. N. Jackson (Kansas City): I desire to emphasize one small factor in the technic of Dr. Beck's work which is not only applicable to the condition which he describes in bones, but can be widely utilized elsewhere. I refer to the use of adhesive plaster to stimulate epithelialization. In 1895, before the Mississippi Valley Medical Association, in Detroit,

I listened to a very interesting paper by Dr. Carter Cole, of New York, on the cure of chronic ulcers. In this paper he outlined his method which, practically speaking, was the use of adhesive plaster to cover and protect the epithelial cells of the granulating surface. I have used that method extensively ever since he first described it, first, beginning with the ordinary chronic ulcers of the various types about the lower extremities. Having obtained remarkable results in this type of cases, I have extended the application of the method to practically all forms of granulating wounds. For instance, when you have wounds of the abdominal wall which have suppurated or have become necrotic, you know how hard they are to heal. If you cover them with ordinary zinc oxide adhesive plaster, the rapidity with which new skin is formed is remarkable.

I think the beauty of the results shown by Dr. Beck, and the wonderful absence of great scarring, are due to the use of the adhesive plaster; and you will find a wide service for it, therefore, in any form of granulating wound. With old burns which, after necrotic suppuration, have reached the stage of granulation you know how slow things are in getting well. You cannot find anything which will promote so rapid a closure of a granulating wound as adhesive plaster covering the granulating surface.

Dr. J. F. Percy (Galesburg, Ill.): I would like to ask Dr. Beck some questions. First, as to the technic he uses with the plaster. When does he begin the use of the adhesive plaster? Second, how often does he change it? Third, how long does he continue its use? Fourth, how does he dress these cases? Fifth, is there any special form of dressing he uses? Sixth, has he ever found it necessary to resort to skin-grafting for these extensive wounds?

Dr. Dean Lewis (Chicago): I think opinions are always going to differ in the treatment of osteomyelitis. There has not been much, if anything, said with reference to bone-plugs. I believe Ashton was the first to introduce skin flaps in the treatment of osteomyelitic cavities; and the purpose for which the pedunculated skin graft was introduced was to close cavities in the tibia, particularly in the upper end, where a large amount of skin was removed at the primary operation. I believe, if the proper work is done with bone-plug at the first operation, there will be less necessity, at all times, for the use of this pedunculated skin graft.

In the last few years I have treated osteomyelitic cavities with sequestrum in a number of different ways, but I think, by all odds, the most satisfactory way is that introduced by Burgess, in which the sequestrum with the hard indurated involucrum was taken out in toto, not healthy bone, and that can be closed with Moorhof bone-plug. I have done a number of operations in which I have treated these cases very much after the manner that a dentist prepares a cavity in a tooth. I have taken out the sequestrum with the hard involucrum, I have carbolized that, and neutralized the carbolic acid with alcohol, leaving in a little alcohol, and have applied the cautery for the purpose of coagulating blood to have a dry cavity, then fill it with the Moorhof bone-plug, suture the skin over, and close it as you would an abdominal wound, or any clean wound. What happens is this: Within a few days the Moorhof bone-plug begins to be extruded. You take this off (it requires no packing or dressing), and it has been my experience in the majority of cases these bone cavities will heal with the Moorhof bone-plug where the primary operation is radical enough to remove the seat of infection. There has been less and less use for the pedunculated skin graft since it was first introduced to close cavities in the upper end of the tibia, but the bone-plug was not resorted to at this time.

Dr. A. T. Mann (Minneapolis): We have been using the Moorhof bone-plug or bone-wax in Minneapolis for twelve years. I saw Moorhof using it in 1904, and he certainly got remarkable results in the cases in which he could practically close the cavity in the chronic and subacute cases. The disinfection can usually be made complete enough to get healing by first intention in the skin and overlying tissues, leaving the wax in as a plug to be gradually taken out. The serial *x*-ray pictures show that perfectly. The formula is 20, 40 and 40—that is, 20 parts of iodoform, 40 parts of spermaceti, and 40 of rapeseed oil. The *x*-ray shows in the first picture as though the bone-wax were made of lead, very clear and sharp. The pictures taken two or three weeks later show that they are beginning to look a little irregular at the margins. In pictures taken ten days later they begin to melt away at the margins, and so on up to about three months, when the wax will be gone, and you will have a callus of bone and connective tissue, mostly bone, in its place.

We have gone a step further than that in the acute cases because some of the infections are so violent that we would not think of closing the wounds. We use carbolic acid, followed by achohol, sterilizing the cavity after it is scooped out. We use wax in such cases. We fill the cavity. The wax is prepared so that it will be fluid at 110°, not hot enough to burn the tissues. It is made that warm over a water bath, and is mixed and poured in. It is a solid wax when it cools to the temperature of the body, and that makes the plug. It can be left in a wide-open place. We put a piece of rubber over the wax, and the wax will stay there for weeks; and all you have to do is to change the outside dressing. The moderate discharges will ooze out about the bone-plug and under the rubber which is over it. This gets rid of the great pain caused by the pulling out of the gauze packings we formerly used, and by the repacking of the cavities with gauze. It makes the dressings easy and rapid, and the healing is fully as rapid as by the old method, if not more so.

Dr. J. F. Binnie (Kansas City): I am very glad Dr. Lewis and Dr. Mann spoke as they have done. In recent years I have come more and more to close, or partially close, osteomyelitic cavities after an operation. I clean out the cavity as thoroughly as possible, take out the sequestrum, clean again as thoroughly as possible, and use the various antiseptics or sterilizers, such as carbolic acid neutralized with alcohol. One should not bother his head about thoroughly drying the cavity. Pack the hole completely with crystals of boracic acid, mixed with a little iodoform, close the wound or leave it open, and apply dressings. I have found this method very effective in a large number of cases; only the outside dressings require changing.

Dr. M. L. Harris (Chicago): Just a word in regard to the reason why osteomyelitis affects, as a rule, the osteogenetic layer. The reason given by the reader of the first paper is not correct. The reason is mechanical. Osteogenesis takes place normally when the circulation has been very much retarded. It seems the slower the circulation at the osteogenetic layer, the more rapid the osteogenesis. If we represent here (indicating on blackboard) the osteogenetic columns at the end of the bone, we find the capillaries going to this layer, suddenly dilate into venous sinuses. Of course, in these venous sinuses the circulation is suddenly reduced in its velocity; it is almost at a standstill. The velocity in the capil-

laries is only half a millimeter a second; in the sinuses, it is materially reduced; therefore, any substance suspended in the blood will tend to settle in these sinuses. If we inject into the blood any insoluble substance of minute size, we find the particles will settle in these little sinuses. Microörganisms which float in the blood—cocci, bacteria, etc.—will do the same mechanically, and that is why osteomyelitis practically always begins in the osteogenetic layer.

Dr. W. D. Haines (closing on his part): I am deeply indebted to those who have taken part in this discussion, because interesting points have been brought out which are really profitable to us all. Practitioners are overlooking cases of osteomyelitis and mistaking them for typhoid. It so happened that, when I wrote to Dr. Beck, I had seen a case in consultation with a prominent surgeon. He had agreed with the family physician that it was a case of typhoid, and the little patient was dying at the time. There was a perforation of the tibia, and there was a bag of pus that neither physician had found. The point I want to impress upon you is, that, if we look for osteomyelitis, we can find it if it is present,—that is, the disease is readily recognized. It is when we get a little careless or are "cocksure" that this is appendicitis or that it is ulcer or that it is gall-bladder disease—then we slip up in our diagnosis.

With reference to the remarks made by Dr. Murphy: I was quoting the late Dr. John B. Murphy, of Chicago, who said: "Take a gimlet, take a nail, take anything that will make a hole in the bone." If you are in the country, these instruments will do just as well. The day of the "dinky" incision is over. We must have a hole big enough to let out pus, and, if we make it early, all this discussion about the use of the bone-plug or bone-wax or other things, to increase the growth of the bone, will lose interest for you.

But there is one other word I want to say before I take my seat, and that is, whatever you do after the storm is over and there is a big sequestrum, do not take it out too soon. It is a good thing to mould the new bone, so that it will not become a little spindle-shaped, attenuated bone, as in the case of the old man presented this afternoon.

Finally, do not try to take out a ten-inch sequestrum through a three-inch hole.

Dr. Beck (closing on his part): We have used this adhesive-plaster method for two years on granulating surfaces, and have given up skin grafting for good. I have used it in amputation of the breast, where I did not have enough skin, and in two or three weeks the entire defect was covered.

About the dressing: Pus forms after twenty-four hours, when the plaster is taken off, and without rubbing the granulations a new piece of adhesive plaster is put on. We do not use zinc-oxide plaster. The adhesive plaster strips cover a part of the edge of the skin, and the edge of the granulating surface, with the center left open. As we take off the adhesive plaster the next day, we find a bluish margin one-quarter of an inch wide, which is newly formed epithelium.

In regard to the mortality: One should hesitate to operate on weak people. I have found that patients with osteomyelitis of this type stand a lot of trauma and long operations without bad results. I have had no mortality in a series of forty-two cases. But the neglected cases of hip-joint disease do not stand operations so well. One of the patients I have here exhibited, who had an operation lasting two and a half hours, wanted to get out of bed on the third day; and the man with the rib-resection walked around on the third day. These patients gain in weight rapidly after operations.

A METHOD FOR CLOSING LARGE RECTO-VAGINAL FISTULÆ

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Fistulæ communicating with canals or hollow viscera having an infectious content, at times offer the surgeon very complicated problems. When these fistulæ give rise to a leakage of gas, feces, or other bad-smelling material, the patient naturally becomes clamorous for relief.

Modern successful efforts to effect a cure may be said to date from Marion Sims' classical case of vesicovaginal fistula. He first demonstrated the principles upon which successful surgery of these lesions is based. The first essential is, that the infectious material must be shed away and entirely excluded from the area in which the plastic surgery is to be done. One of the great stumbling-blocks of the early surgeon, which, even yet, often rises up to plague us, is the introduction of sutures in such a manner that they will not enter the septic canal, and thus serve as pathways for infection to travel into the field of, and undo, the plastic work.

The second essential is, that there shall be no tension of the coaptation sutures. This principle finds an almost perfect demonstration in the almost uniform success of the operation of primary perineorrhaphy, though often done under most unfavorable circumstances and in a technically unskillful manner.

The colossal stretching to which the levator ani has been subjected by the passage of the child's head, temporarily paralyzes the muscle, and, in consequence, there is no tug on the suture-line.

The operation devised for the case, the report of which is given below, seemed to me the only way successfully to meet the essentials for success mentioned above.

Case—Mrs. M. aged 50, widow.

Family history: Negative except as to tuberculosis from which disease the patient lost two sisters.

Personal history: Childhood, negative; menstrual history began at 14 years of age, normal; now in the climacteric; married at 17; IX-para; oldest child, 31, youngest 11; labors, all natural, lacerations of cervix, and perineum, recoveries normal.

Stomach history, points strongly toward an intrinsic lesion of stomach or an extrinsic reflex indigestion. This aspect of the case was not followed further than the clinical history and physical examination for the reason that the patient refused.

One month ago the patient was operated on by her physician for repair of the cervix and perineum. The work on the perineum was followed by infection, high fever, and sloughing, the slough leaving a communication with the rectum larger than a half dollar, just within the sphincter ani. For the latter condition, patient is referred to the surgeon by her physician.

Examination.—The patient is an anemic, spare woman; pulse, 86 and remittent; temperature, 99°; chest, negative. There is marked dilatation of the stomach, with slight tenderness over the region of the pylorus; abdomen, otherwise negative.

Pelvic examination shows a low uterus and a rectovaginal fistula, as described above. Practically the entire rectovaginal septum is gone; abundance of scar-formation; levator ani retracted laterally can be palpated better from the rectal than from the vaginal side. The patient was operated on at Wesley Hospital, April 21, 1915. The operation began as a typical Whitehead, the rectum being freed sufficiently high to slide over the defect; then sutured to anal margin, and the redundant portion cut away. With the rectum excluded from

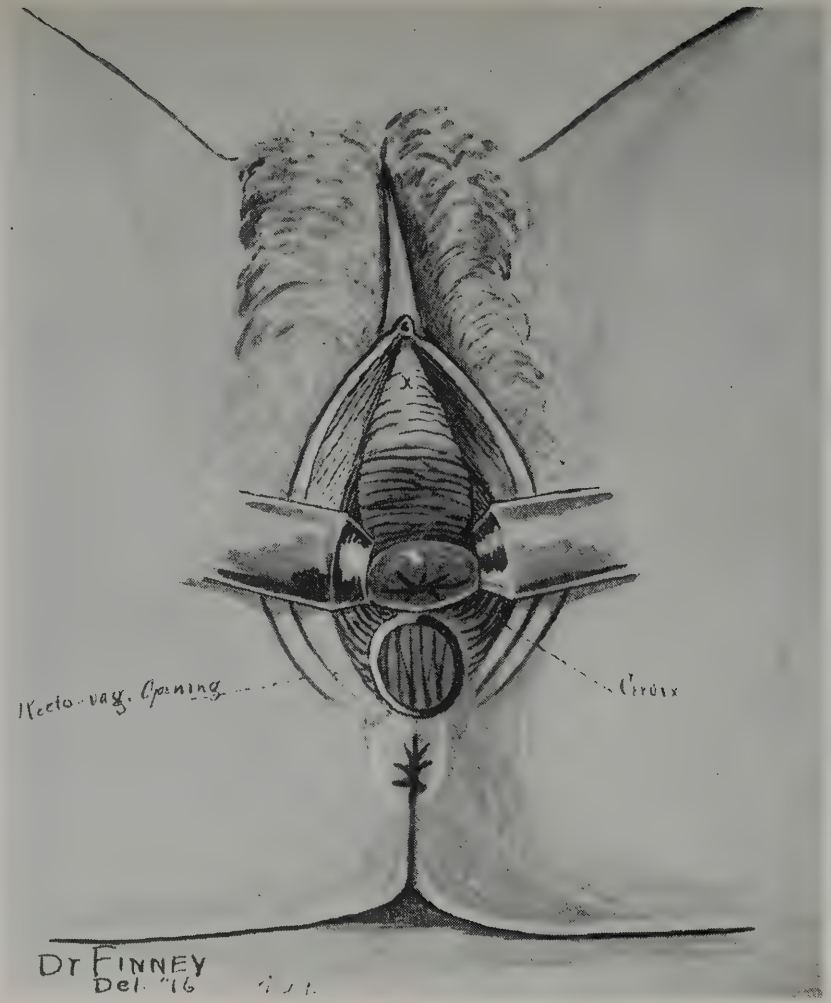
Recto-vag. Opening
Cervix
Dr Finney
Del. '16

Fig. 1.

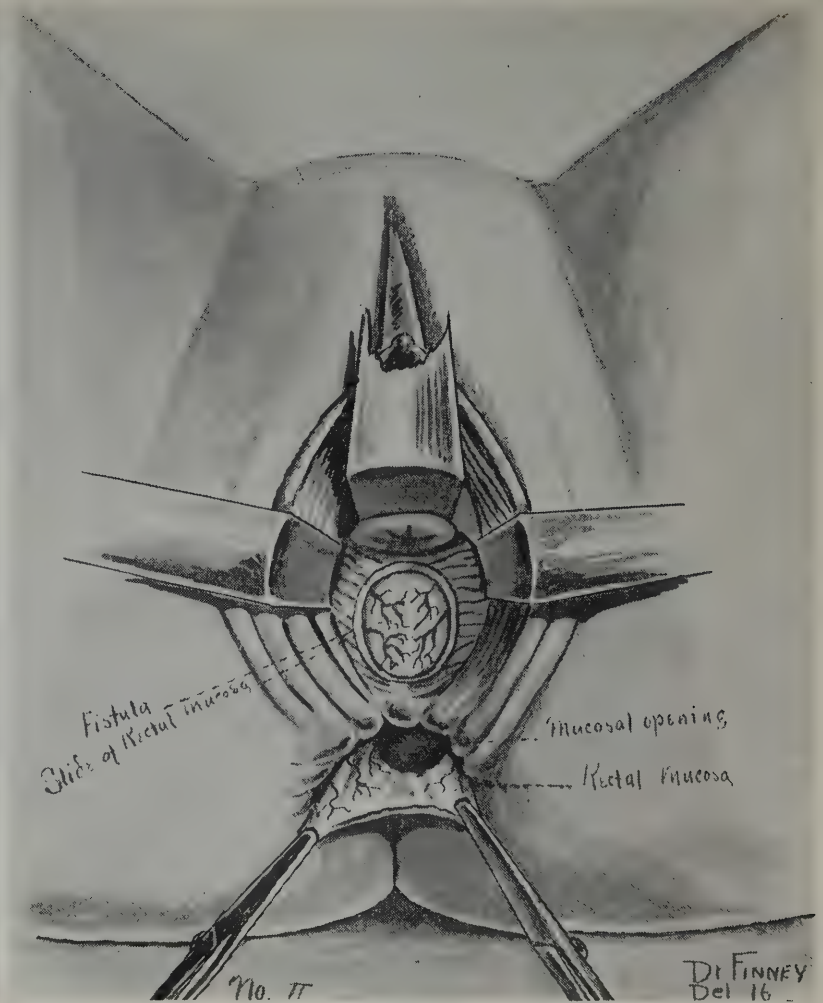
Fistula
Slide of Rectal Mucosa
Mucosal opening
Rectal Mucosa
No. II
Dr Finney
Del 16

Fig. 2.

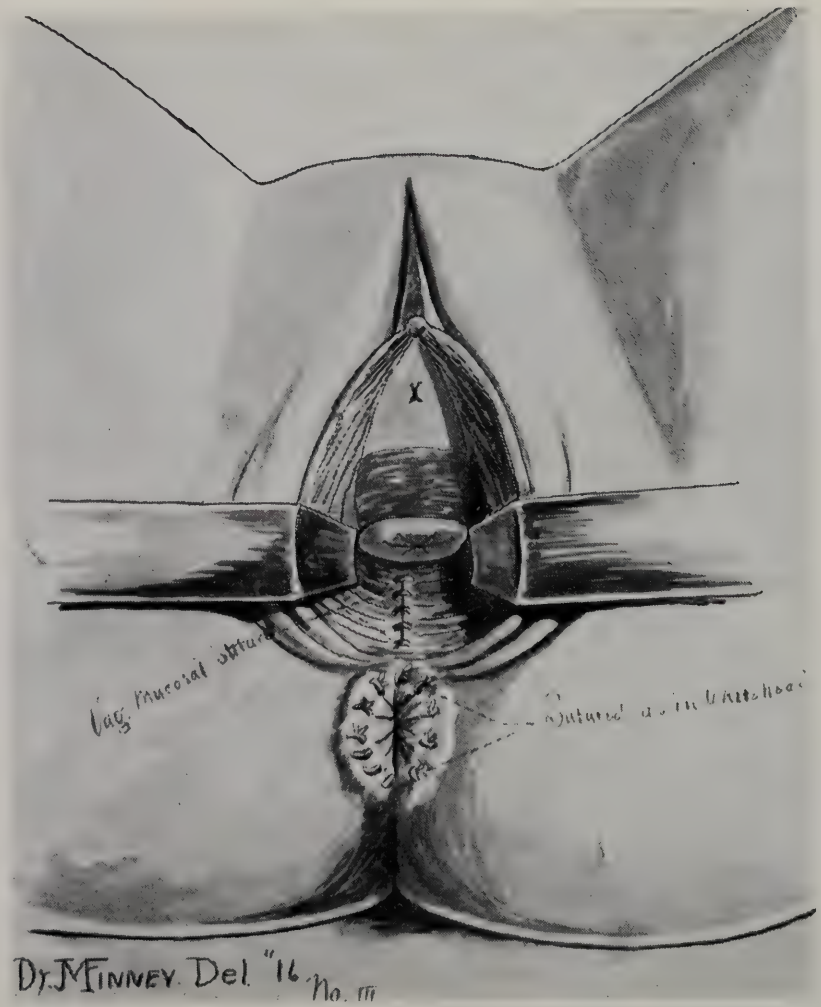
Vag. mucosal suture
Sutured as in hare-lip
Dr. J. M. Finney. Del. '16
No. III

Fig. 3.

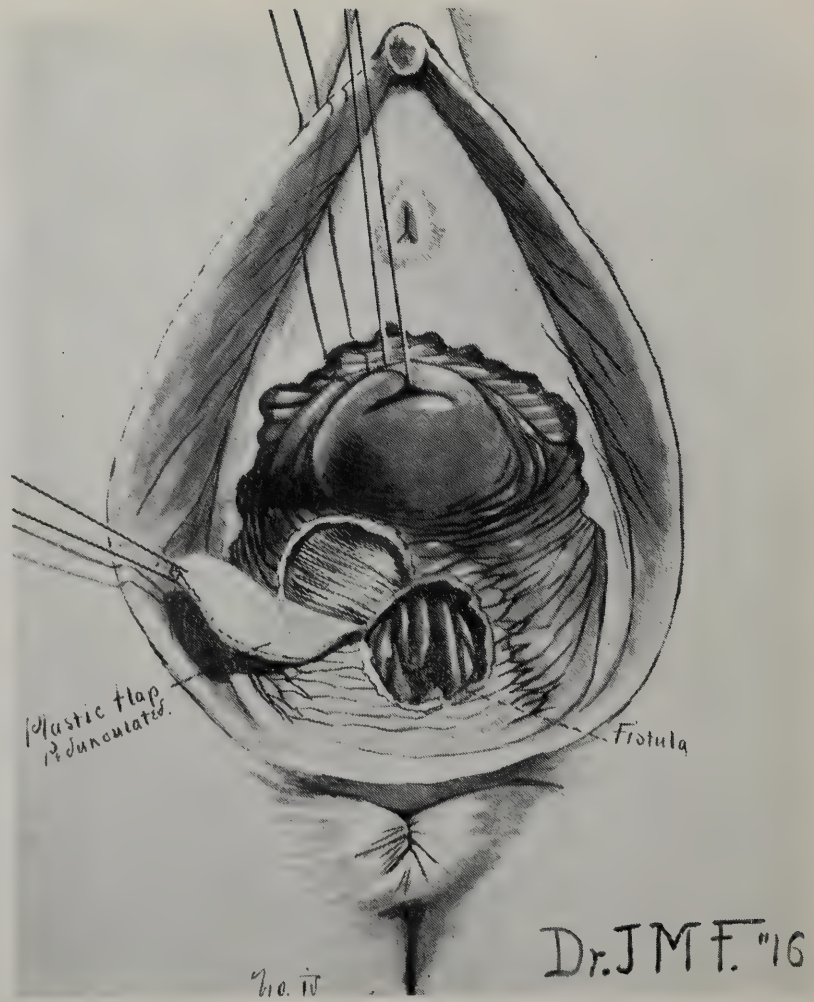
Plastic flap
Fistula
Dr. J. M. F. '16
No. IV

Fig. 4.

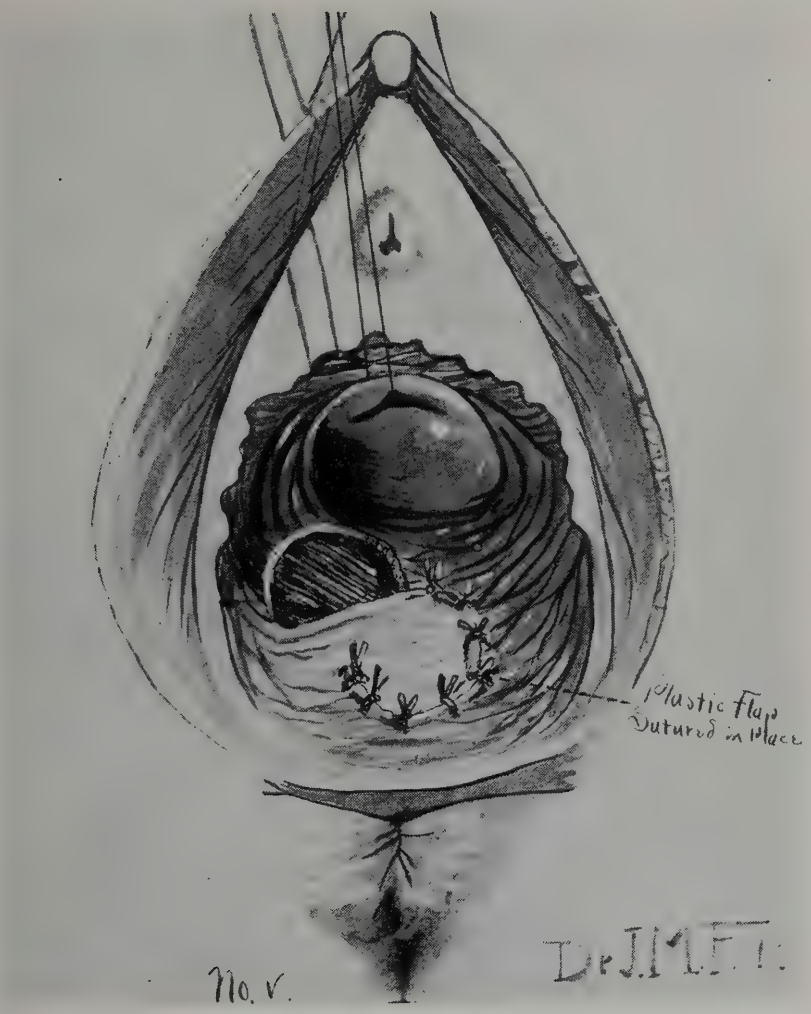

Fig. 5.

Fig. 6.

the field of operation, the parts, as well as the surgeon and the assistants, were again sterilized, and the operation continued as a typical perineal restoration. The raw rectal mucosa was covered first with the levator ani sutured across, then with vaginal mucosa in the form of a transplanted pedunculated flap. (See illustrations.)

Result, primary union throughout, and cure.

The difficulty in this case lay in the fact that from the extensive tissue destructive coaptation with rectal exclusion by any of the standard operations would have been almost, if not quite, impossible.

DISCUSSION

Dr. H. P. Ritchie (St. Paul): The case reported by Dr. Blesh is rather unique in my experience, as it occurred following ordinary perineorrhaphy. I have seen the rectum invaded under these circumstances on two occasions, both times rather late in the dissection of the perineum, with the tissues pretty well mobilized. It is then quite possible to invert the edges of the tear into the lumen of the rectum, and proceed with the repair of the perineum. In one of these cases there was absolutely no sign of the accident, and it went to primary repair. The other case concerned us for three weeks, with the possibility all the time of the formation of a gas fistula, but healed spontaneously and no secondary operation was needed. Small gas fistulæ that have followed secondary repair of the complete perineum can readily be closed by mobilizing the tissues and pursuing this simple technic.

Of the large fistulæ, such as the doctor has shown here, I have seen three,—that is, fistulæ large enough to permit the passage of fecal matter through the vagina. These have all followed the primary repair of the complete laceration,—that is, immediately following delivery, and were of the size of a dime to a quarter. In operating in the first case, we discovered that the ridge below the fistula contained but little, if any, muscle fibers, so I cut it, and converted the situation into a secondary repair of a complete laceration. This technic of vaginal flap we are all familiar with, and practically in every case we expect a satisfactory result. It seems to me that this is ideal for the larger fistulæ, not only for their cure, but to obtain competency of the muscle structures at the same time. This case was satisfactory, indeed, and I applied the same technic in two other cases. In the third case

in this bar there seemed to be definite muscle structure. The Whitehead operation is no longer an accepted operation for hemorrhoids, from the fact that it does nothing more than cut off the blood supply, and, as Dr. Gant showed today, is liable to be followed by serious after-effects. But its principles are now applied to the cure of fistula in ano as suggested by Elting, and have met popular favor. Dr. Blesh comes here reporting a case of vaginal fistula cured by applying the Whitehead technic, which may be used, not only for the larger fistulæ, but for the smaller ones as well. It seems to me that we should congratulate him on his suggestion and on his result, because the large fistulæ present a very difficult problem. I still feel, however, that this bar below in the larger fistulæ should be observed as to whether there is muscle structure, and when found wanting that a conversion of the situation into a secondary repair for a complete laceration will yield satisfactory results.

Dr. A. E. Hertzler (Kansas City): There is one little point in connection with the technic of the operation that I would like to mention, and that is, the rectum must be sufficiently mobilized about its entire circumference, otherwise retraction of the rectum is likely to pull out the sutures.

Dr. Charles Souther (Cincinnati): I believe Dr. Blesh has presented to us a technic which is analogous in principle to the one published and advocated by Ristine in the closure of complete perineal tear. He brings the rectum down sufficiently to reach its normal position, which converts a fistulous case into a simple perineal laceration. If the muscles are in the way, they are immediately divided in the fistula case. In the perineorrhaphy, of course, they have already been torn. This procedure converts a complicated operation into a simple perineorrhaphy, and the muscles can be readjusted; and it has been my experience that the operation can be done without failure.

Dr. A. W. Abbott (Minneapolis): In closing fistulæ which involve a laceration of the perineum including the sphincter ani, it has been my custom to make an incision through the vaginal mucosa only, about an inch from the edge, but surrounding the entire opening; and to dissect this mucosa down to the rectal mucosa, taking care not to pierce it at any point, and then turn this flap forward like an apron, so that the vaginal mucosa becomes the rectal. This keeps the vaginal part of the wound clean. In operating on fistulæ that are

high up, I have never found any difficulty, after first thoroughly cleansing the rectum and making a fine closure of the freshened rectal mucosa, in making a closure of the vaginal part. This, of course, does not apply to some enormous fistulæ.

Dr. Edward Evans (La Crosse, Wis.): As illustrating the value of the method of Dr. Blesh, I would like to report, briefly, a case where this principle was applied. A man had been operated on by the perineal route for enlarged prostate, with resulting urethrorectal fistula. To cure this, the sphincter ani had been cut reaching back to the fistula. This resulted in a fairly bearable condition being converted into an unbearable one. Previous to this the patient had to empty the rectum several times a day. Now the sphincter was weakened, and it constantly leaked. He came for relief. I applied the principle illustrated by Dr. Blesh with complete success. On account of the scar tissue where the prostate had been removed and the distance of the fistula from the anus, it was difficult. By mobilizing the rectal mucosa freely and drawing it down, I was able to cover the fistula, after closing the urethra over a catheter, tied in, and in this way I got complete primary union, and the cure of a very disagreeable condition.

Dr. Blesh (closing): I have offered this method merely because it helped me over what was seemingly an insurmountable difficulty. With regard to the bridge of tissue and its contained muscle structure: I stated in the beginning that this fistula extended down to and was just within the sphincter ani, which I had no difficulty whatever in demonstrating; that it involved the levator ani, and, in order to restore this patient to her natural state, restoration of the levator ani was one of the first essentials after the closure of the opening and the exclusion of septic matter.

So far as the Whitehead operation for hemorrhoids being more or less in disrepute at the present time, I wish to say that this operation, when improperly performed, will most certainly lead to evil consequences. When the Whitehead operation is finished with strong eversion of the rectal mucosa, if there is too much destruction of the skin, it will cause trouble afterward through erosion and ulceration of the everted and exposed rectal mucosa; that is one of the postoperative difficulties in the Whitehead operation for hemorrhoids. If one is careful and makes the incision along the

mucocutaneous border, this untoward result will not happen. Many instances have been brought to my attention in which the rectum has been invaded in the attempt to do the ordinary second degree perineorrhaphy without such untoward results as happened in this particular case, but in this case evidently the stitch had penetrated the rectum, and made a continuous passage for septic fecal matter into the cellular tissues in the perineum and about the muscular structures, causing an extensive sloughing, and one in which I found it impossible to slide the tissues of the vagina across by any of the ordinary methods.

SURGERY OF LIVER TRAUMA

Oliver J. Fay, M.D., F.A.C.S.

DES MOINES, IOWA

The advent of steam transportation, the rapid development of all industrial activities, and the ubiquitous motor vehicle have given to traumatic surgery an increasing importance. A high percentage of traffic and industrial injuries, and particularly of the former, may be termed major injuries; and rupture of some viscus, the "internal injuries" of the newspaper man, is responsible for the high mortality. In Geill's report of 474 autopsies performed in cases of traumatic rupture of viscera, ruptures of the liver were found in 296 cases, or in almost 60 per cent of the total number. In the older statistics of Edler, 365 cases were reported with injuries to the liver in 189, or 52 per cent. Since injuries to the liver occupy so dominant a place among the traumatic lesions of the abdomen, any further explanation of my choice of subject seems superfluous.

The question of the treatment to be employed in the presence, or suspected presence, of injury to the liver is answered when the diagnosis is made—laparotomy is indicated in every case of probable rupture of the liver. The injury to the liver *per se* is of secondary importance, for such injuries exhibit a marked tendency to heal, either by connective-tissue cicatrization or, to a lesser degree, by regeneration; but the danger from hemorrhage, imminent even in lesser

wounds of the liver, is imperative. The liver is not only extremely vascular (the spleen alone has a richer blood supply), but its veins, lacking valves and their walls securely bound to the canals through which they run by the minimum amount of cellular tissue which invests them, do not contract when sectioned. The arteries, surrounded by the fibrous capsule of Glisson, contract and check arterial hemorrhage, but, with the constant influx of venous blood, hemorrhage from the hepatic veins may assume enormous proportions within a comparatively short time.

The time for operation is still made a bone of contention. The arguments, pro and con, are, on the whole, those which apply to all cases of abdominal trauma, but here the greater danger from hemorrhage must be considered, not alone from primary hemorrhage, but from secondary hemorrhage as well, for secondary hemorrhage may be brought on at any time by a movement of the patient in bed, by sneezing, coughing, or vomiting. Too much insistence cannot be placed upon this danger from hemorrhage. In 150 of the 152 cases reported by Edler in which death was due to the liver injury, hemorrhage was responsible for the fatal outcome, in 62 cases within the first 24 hours, and in the remaining cases on the second or some subsequent day. The imminent danger from hemorrhage may even invalidate the general rule of traumatic surgery of the abdomen—to relieve shock before undertaking operation.

The technic of operations upon the injured liver is primarily governed by the first canon of traumatic surgery of the abdomen—maximum of speed and gentleness in operating. A second canon of hardly less importance is to explore painstakingly all other abdominal viscera to preclude the possibility of overlooking some concomitant lesion. In an appalling

number of cases an injury to the liver is "successfully" repaired only to have the patient go on to autopsy, instead of to recovery, with the embarrassing discovery that lesions of some other organ or other injuries to the liver had been overlooked.

Special indications may determine special incisions, but for a majority of cases the high median incision will be found the most useful, since it makes possible the necessary inspection of other viscera. To give better access to the liver, a second incision, extending from the upper angle of the first incision along the border of the costal arch, may be required. If still more space is necessary, one or more ribs may be resected, or the liver may be mobilized by severing one or more of its ligaments.

If the hemorrhage from the liver is found to be so profuse as to necessitate its immediate control while steps are being taken towards definite hemostasis, compression of the aorta above the celiac axis by an assistant, has been advised; or the left hand of the operator may be introduced into the foramen of Winslow and, exploring its inferior pole with the index-finger, the hepatoduodenal ligament found and compressed between thumb and index-finger. Various other more complicated methods have been suggested for the temporary control of hemorrhage, but practically all of them have been based upon experimental rather than upon clinical experience; in practice they are too time-consuming, or have some other special element of danger. Even compression of the aorta or of the hepatoduodenal ligament will be of practical value only in rare instances, and tamponing will be found the best expedient in practically all cases. The tampons used should be of gauze and, save in exceptional cases, of large size—either generous squares or

long strips several inches in width. Mikulicz' tampon is sometimes also employed.

A certain amount of force must be exerted in tamponing these wounds to insure the filling of the entire defect, and the effective control of the hemorrhage. If the laceration is superficial but extensive, several layers of gauze may be firmly pressed against the bleeding surface, and held in place by catgut stitches. Where the situation of the wound makes the direct application of tampons impossible, hemorrhage may still be controlled by the judicious use of large pieces of gauze, that is, by indirect tamponing. Hemorrhage high in the right lobe is controlled by firmly tamponing the subphrenic space, while the subhepatic space is well packed to give counter-pressure. This indirect tamponing is also often a valuable adjunct to direct tamponing, or some other measure to control hemorrhage.

Ligation of bleeding vessels is another important measure, and is particularly valuable when associated with tamponing.

Intrahepatic ligation for the control of hemorrhage from the liver has had many advocates; and we may choose from a half score and more of more or less related methods. In most of these, through-and-through sutures of single or double strand are passed from the concave to the convex surface of the liver a short distance beyond the bleeding point, and at intervals of from 1 to 1.5 cm. Loops are left on one or on both surfaces, and these are then cut and tied, with or without the employment of some sustaining material, such as whalebone, plates of magnesia, decalcified bone, small rolls of gauze, or a rubber tube. The differences between the various methods are largely concerned with the employment of a single or a double strand, the order in which the loops are

tied, whether or not they are tied over some sustaining material, and the nature of this support. The needles employed are always blunt, and usually curved; and the ligature is most often catgut of large size, since its swelling is of service in closing the wound made by the passage of the needle. Unless the ligatures are tied tightly there will be bleeding from the small vessels, which remain open though the larger vessels have been closed. Well-tied ligatures control the hemorrhage satisfactorily in a large number of cases, but, if the ligature is too tightly tied, there is danger of cutting through the friable parenchyma. The exactness of the technic required,—an exactness which must remain largely a matter of chance in a procedure so rarely employed as is this one,—and the fact that most of the materials suggested for supporting the sutures are not found in the equipment of the average operator, rob intrahepatic ligation of most of its practical value in emergency surgery, whatever its importance in resections of the liver may be.

Suture is the ideal treatment of subcutaneous injuries of the liver; it restores the tissues to a condition as near normal as possible, thus hastening the process of repair; it should give complete hemostasis, and, by thus obviating the necessity of draining the wound, hasten the patient's recovery. Clinically, however, many contra-indications are found; the suture of the rupture is apt to be time-consuming, and the condition of the patient often demands the briefest of operations; where there is a loss of liver substance, where the lips of the wound gap widely so that considerable force would be required to approximate them, or where they are irregular or torn, suture is again impracticable. Finally, in many cases of suture, drainage is still necessary, and suture then loses its chief advantage over tamponing.

The methods of suture, both simple and sustained, are largely parallel to the methods of intrahepatic ligation. Of the methods of sustained suture, as of the methods of sustained intrahepatic ligation, it may be said that, while they lack nothing in ingeniousness and technical wizardry, they are, on the whole, lacking in practical value, at least in so far as traumatic surgery is concerned.

The use of autoplastic tampons (muscle, fascia, and fat) to control hemorrhage has found much experimental support, particularly in hepatic surgery, where the difficulty of controlling hemorrhage keeps keen the interest in any new method of hemostasis. Because of the added time and trauma necessary to secure the required amount of muscle or fascia, and the ease with which omentum can be secured, the latter has been the favorite material. Binnie, Boljarsky, Loewe, and many others have advocated its use, yet opposing voices have not been wanting. This method has in its favor that the trauma and danger of secondary hemorrhage from the removal of gauze tampons is avoided, the closing of the wound hastens recovery, the material is easily obtained, and the technic is simple. On the other hand, there is not lacking experimental and clinical evidence that the omental patch may be forced outward by the hemorrhage, and a pseudo-cyst formed; portions of the omentum used as a plug may become necrotic; hemostasis may not be complete; and in many cases drainage is still required. From this contradictory evidence we may conclude that this method is not applicable to all cases of rupture of the liver, but might be profitably employed in carefully selected cases, usually associated with the ligation of large vessels, or the suture of a rupture. It would seem especially applicable to cases in which there has been extensive excoriation. The piece of omentum

should be somewhat larger than the area to be covered. It is severed distally to a ligature, and attached to the surface of the liver by a few stitches.

Where a lobe of the liver has been badly lacerated and necrosis seems probable, or where a lobe (the left in almost all cases) has been almost detached, a choice must be made between resection of the lobe and its isolation by tampons until such time as the necrotic tissue may be discharged. On one side of the balance we have the immediate danger from prolonged operation; on the other the danger from suppuration and a possible secondary hemorrhage. The deciding factor must be the present condition of the patient; resection is preferable wherever feasible, but in the operator's enthusiasm for the ideal operative procedure, he must not lose sight of the fact that uncertain recovery is to be preferred to certain death. Moreover, necrosis is to be considered assured only when the damaged lobe is pale and anemic, and, more particularly, when the left branch of the hepatic artery has been severed. Resection here consists in little more than the snipping of the remaining small isthmus. In addition to the methods of hemostasis employed in other injuries to the liver, through-and-through suture sometimes renders good service here.

The use of cautery to control hemorrhage from wounds is a very old procedure, but with the advance of science it has fallen more and more into disrepute. Its employment in traumatic surgery of the liver still survives to some extent, which is a fact to be regretted. The process is at best a slow one, and any prolongation of the operation is momentous; and there is danger from secondary hemorrhage, not only following operation, but also at a later period when the eschar becomes detached.

A number of chemical hemostatics have been recom-

mended, among them gelatine, suprarenin, adrenalin, carbolic acid, chloride of lime, and antipyrin. It is difficult to secure really sterile gelatine without impairing its coagulative qualities. Chloride of lime has not been found very efficacious, while carbolic acid shares the vices of thermal cautery. Suprarenin and adrenalin have both given some satisfactory results experimentally, but, as with other chemical agents, the duration of their action is limited, and the question of secondary hemorrhage looms large. Amante considers antipyrin the most satisfactory chemical hemostatic because it does not injure the tissues, it is sterile and even antiseptic, it acts rapidly, it is not toxic except in extreme doses, and no eschar results from its use. This list of its virtues is a long one, but even Amante does not recommend its use alone. Large vessels must be ligated, but it is said to be of service in controlling oozing, and in preventing secondary hemorrhage.

RECAPITULATION

Operations upon the injured liver should be performed with all the speed compatible with gentleness and a thorough examination of the abdominal viscera. Temporary control of the hemorrhage is usually to be obtained by tamponing. Suture of the wound, ligation of the larger vessels, and tamponing are the most serviceable definitive procedures.

Suture may be employed in cases where there is little or no loss of substance, and the wound is clean-cut. It may be preceded by the ligation of larger vessels, and in many cases must be supplemented by tamponing.

Ligation of the larger vessels is to be employed wherever there is troublesome hemorrhage from accessible wounds. The wounds may then be tamponed, either directly, or indirectly, or sutured.

Tamponing is the method employed in the largest

number of cases. It effects temporary hemostasis until other measures can be employed; it controls hemorrhage from wounds which are inaccessible, or which could be reached only by an unwarranted incision; it is the least time-consuming procedure, and is, therefore, the method of choice where the patient is in a precarious condition, and brevity is the first essential; it is a valuable adjuvant to suture of a wound where hemostasis is not assured, or the possible presence of other liver injuries cannot be excluded, and in every case where the simple ligation of vessels has been employed; and it is essential where the presence of infection cannot be excluded.

Immediately following operation, profound shock may give rise to anxiety, and is to be combated in the usual manner. Continuous proctoclysis is to be instituted in every case, and continued for at least forty-eight hours. Any violent movement is to be avoided because of the danger of secondary hemorrhage, and the restlessness of the patient must be controlled by morphine or a derivative. Post-operative vomiting must be checked by gastric lavage. Straining at stool is to be guarded against by the use of enemata. In rare cases, dilatation of the stomach is a troublesome or even dangerous complication; it is best combated by placing the patient on his abdomen, by raising the foot of the bed, and by gastric lavage.

The tampons have been removed with impunity as early as the second and as late as the twenty-fifth day, but in other cases hemorrhage has followed too early removal and necessitated repacking. Where the wound has been sutured or is very small, the tampons may be removed at a relatively early period; but in graver cases, and particularly those in which the tampons have been the chief method of treatment, they should be left undisturbed until the seventh or eighth

day, and then removed slowly, a little each day, until on the tenth or twelfth day their removal is complete. The greatest care and gentleness are, of course, essential in removing the gauze.

DISCUSSION

Dr. Roland Hill (St. Louis): I would like to say a word or two with reference to the paper presented by Dr. Fay. The blood-pressure in the liver is about as low as any place in the body, and these wounds of the liver, if at all clean, can be coapted by suture. I think the essayist is in error when he says that these sutures should be tied tightly. If brought together gently the bleeding will be effectually controlled. I have done this a number of times. Any force will cause the suture to cut through the liver substance. If you have laceration of the liver, the packing may or may not be associated with suturing, but in a clean cut, even an extensive cut, of the liver, suturing is an ideal method because of the low blood-pressure, and you just simply tie the sutures tight enough to coapt the cut surfaces.

There is a needle especially made for liver-suturing, devised by Dr. Cullen, of Baltimore, that is very efficient, but any non-cutting needle can be used.

Dr. W. R. Cubbins (Chicago): With reference to this subject of lacerations in the liver, Dr. Fay spoke of subhepatic packing. That subhepatic packing in conjunction with subdiaphragmatic packing will hold all right where the costal arch is high, but in a flat arch you are almost certain to get obstruction of the duodenum with an acute gastric dilatation, which is a serious complication.

Dr. D. S. Fairchild (Clinton, Iowa): I take it that the author of this paper intended to call attention to certain life-saving procedures in cases where the liver has sustained serious injury. It is quite true that there are questions which will come up later that may need surgical attention.

The question of rupture of the liver, which so often involves other organs, is a very interesting one, as the rupture is very likely to be fatal in a good many instances. Of course, the question now is, what can be done to tide these patients over until we carry out some of the measures Dr. Cubbins mentioned? If the liver is lacerated, what can we do but pack the wound so as to stop hemorrhage and take care of the liver later on? Whatever is necessary, if we have an

incised wound of the liver, suturing is certainly a very desirable thing, and that can be easily provided for by taking a Hagedorn needle, and pushing the eye through, threading it, and bringing it back, you can introduce your suture without a specially contrived needle for this purpose. By carefully arranged sutures, a good deal can be done in tiding the patient over.

In gunshot wounds the question of packing is one that is rather important sometimes. These wounds are so often likely to be infected that it becomes necessary for some drainage to be provided for, and that is provided for in the packing which is employed, and in gunshot wounds, of which we have had a few, we have been able to put in a small drain of gauze, packing it in not very tightly, because the liver will not tolerate very tight packing, and so it is in lacerations of the liver.

In our every day work, the question arises, what can we do now to tide the patient over, and then take up the question of what may be done afterwards?

Dr. F. T. Murphy (St. Louis): I would like to ask Dr. Fay one question, namely, how much of the liver may be detached, and yet not have serious results from it?

I ask this question because of a case we had recently. A man was brought in late in the morning from a motor-cycle accident. He was not considered seriously ill in the first hour, but was getting worse. He was seen by me, and a rather indefinite diagnosis of some intra-abdominal injury was made. On exploration a piece of the right lobe of the liver as big as a small fist was found absolutely detached and lying free, with a certain amount of hemorrhage. There was no hemorrhage from the liver at the time of operation; but there was some theoretical discussion as to what might be done with the piece of liver. One of the enthusiasts on the house staff felt it should be left and wrapped up in omentum, and see what would happen. It was easy to take it out, and it seemed the safest thing to do. This was done, and the man recovered.

In looking over the literature of these cases I find there is no definite statement made as to what becomes of this free piece of liver, or how big a piece might be left.

Dr. W. T. Coughlin (St. Louis): In discussing surgery of the liver I find there are a few things mentioned that

are very important, and there are some others that have not been mentioned.

The worst case of intra-abdominal hemorrhage I ever got into was due to a lacerated wound of the liver. The patient was brought in, and there was no wound on the surface of the body at all. He gave a history of having been crushed between a wagon and a post. He was having considerable pain in the right side. He was in great collapse, and there seemed some evidence of dullness in the right flank. He clearly showed signs of hemorrhage. Some hours after his admission it was decided to open the abdomen with the consent of the friends, but this was refused at first. A large clot was encountered just below the liver, with a deep laceration of the right lobe of the liver extending well toward the median line. It went from the edge nearly three inches toward the center of the liver or toward the thickest part of the liver. We loosened the clot in that laceration, and there was profuse hemorrhage. The patient was nearly exsanguinated beforehand, could not stand very much, and further loss of blood would greatly endanger his life. Fingers were introduced into the foramen of Winslow and pressure made on the vein. (I believe that most of the bleeding from liver wounds can be controlled temporarily by pressure on the portal vein.)

Bleeding from the laceration was effectively controlled in that way, and then stitches were passed through, and the edges just approximated, and nothing more, and the pressure on the vein released. By holding with the hands on the sides of the laceration to further help out the action of the stitches for fear there might be more hemorrhage, the edges were closely approximated. It was observed that very little hemorrhage occurred. Pressure was gradually released, and there was no more hemorrhage. If the edges are brought together fairly accurately, that will be enough to control hemorrhage because of the lower blood-pressure in the liver. If a small laceration exists, I do not think we need to bother about it. It is only when large vessels in the center are bleeding that one has serious trouble.

With reference to incised wounds of the liver: In one case I tried to excise a portion of the left lobe of the liver, and it was tied off with chain stitch first, and catgut was used. The edge of the left lobe of the liver seemed perfectly blanched. As soon as the stitches were tied, a portion of the liver was removed with the cautery, and there was no bleed-

ing. However, that patient began to show signs of hemorrhage, and the next day he did not show signs of hemorrhage until night or until after reaction set in. I knew nothing about it until the next morning when we found the pulse up to 150. I was tempted to open the abdomen again, but counsel advised against it, saying if I did so the patient would die. The patient was suffering from "delayed shock." I think delayed shock, by the way, is always either hidden hemorrhage or collapse. We used salt solution, and caused the death of the patient by washing out the rest of his blood. At autopsy we discovered the chain stitches were quite loose. That is what we might expect probably because most of the liver mass is made up of blood itself. In talking over the case it was suggested to me that the catgut sutures lengthened after they were tied. Catgut does stretch, and the catgut was used dry. It was chromicized in its preparation, and had not been drawn through a wet towel before being handled. I am glad to think that this may have conduced to the hemorrhage. There was no other place he could have bled from, except from the free surface of the liver.

Of gunshot wounds of the liver we have had a great many, and sometimes they are very bad. Sometimes they bleed a great deal when the bullet perforates close to the hilus of the liver. In one case the bullet entered low in the right lobe and came out close to the gastrohepatic omentum. This wound bled freely. A probe was passed through threaded with string, and to the string was attached a gauze strip, and that, drawn through loosely, soon controlled the hemorrhage.

Dr. A. E. Hertzler (Kansas City): For the sake of literary exactness, I would suggest to Dr. Fay that he change the title of this paper. The problem is not one of traumatic surgery, but one of the surgery of liver trauma, the trauma being due to some outside agent and not to the surgery.

Dr. D. W. Basham (Witchita, Kan.): Inasmuch as Dr. Hertzler has mentioned the omentum, which lends its help to the surgeon so readily and so often, I wish to call the attention to a little procedure whereby stitching of the liver may be rendered much more effective and safer. The best needle of which I know for suturing the liver is that of a Russian surgeon. The natural friability of the liver tissue makes effective suturing difficult. The sutures are prone to

cut out, and create new wounds, instead of serving to close one. To obviate this difficulty, split the border of the omentum and place a leaf on both surfaces of the liver and over the wound to be sutured. Then pass the necessary number of sutures, preferably of No. 3 or 4 catgut, at a distance of an inch or more from the margin of the wound. The sutures should pass through the lobe of the liver even if the wound does not, and should include strips of omentum placed longitudinally with the wound on both surfaces in such a manner that when they are tied the effect is much the same as when the deep sutures used in closing an abdominal wound are tied over a piece of gauze. The sutures should be tied with barely sufficient firmness to approximate the edges of the wound. I believe it would be feasible to employ two strips of fascia, instead of the omentum, to prevent the sutures from cutting out. While it is undesirable to displace the omentum in this manner it affords us a means of dealing more safely with an emergency. After the patient is well the adhesions may be disrupted, and the omentum replaced in its original situation.

Dr. A. E. Benjamin (Minneapolis): I would suggest the use of long flexible rubber tubing, which will fit nicely on each side of the tear, tying the sutures over these tubes, which will answer for drainage. In this manner you can operate quickly, and can lessen the pressure of the suture, so that it will not cut through the liver. We employ the same method in taking out the gall-bladder, with slight hemorrhage, putting in a cigarette drain. In the same way we can use rubber where a piece of the liver has been taken out.

Dr. H. E. Pearse (Kansas City): I want to endorse the position taken by Dr. Fay because I think the method he has described is of value in the desperate cases of laceration of the liver, and I desire to report a case that will answer the question about leaving a tampon.

On the 27th day of April there came into the service of Dr. Binnie in the General Hospital, Kansas City, a man who was suffering from a crushing injury of the right side of the chest. He was in profound shock. When the doctor opened the abdomen he was met by hemorrhage near the central fissure of the liver, so much so that he could not think of stopping to suture it. (When Dr. Binnie operates his mind is concentrated on what he is doing, and he does it well.)

The wound was packed with iodoform gauze. The service was changed on the next day when the man came under my care. Three days later Dr. Binnie looked over the patient, saw that he was doing very well, and said the packing would be taken out at the proper time. I had Dr. Binnie see the patient again at the end of the week, when he advised taking out the gauze as soon as it loosened, but not to pull it out forcibly. At the end of the fifth week we began the removal of the packing. We removed at least three yards and a half five weeks after it had been inserted. The patient made a perfect recovery.

Dr. Fay (closing): When it is easy to close a lacerated wound of the liver by suturing, that method should be employed, but, as Dr. Fairchild has pointed out, this particular paper deals with urgent surgery of the liver. It is the immediate attempt to save the patient's life that is indicated in these cases.

I stand corrected by the gentleman from Kansas City (Dr. Hertzler) as to the proper title for this paper. He has the right idea.

I am also obliged to Dr. Hertzler for telling us about a piece of detached liver. He believes that the omentum will do almost anything in the abdomen, and I must agree with him. An entire lobe of the liver has been removed without doing any apparent permanent damage to the patient.

The report of Dr. Binnie's case in which three and a half yards of gauze were used, and removed at the end of five weeks, is very interesting. I believe that the tampon was left in place longer in this case than in any recorded in the literature.

POSTURE IN ABDOMINAL DRAINAGE

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It is a generally recognized fact that the posture in which patients are placed after operations for septic abdominal conditions, is an important factor in their recovery.

It is well to remember that surgery demanding abdominal drainage is the surgery of delay. Oftentimes the vitality of a patient is seriously impaired before the case is turned over to a surgeon, and the margin tending towards a safe operation may be very small or entirely absent. In all cases where drainage is necessary there is one vitally important point to be kept in mind, and that is the fact that drains are usually effectual for but a little more than twenty-four hours. Their effectiveness is at its maximum immediately after operation, and this tends to lessen from hour to hour. Unless sufficient drainage takes place in the first few hours the patient is likely to die from peritonitis or sepsis. It will thus be seen that in the gravest surgical cases, it is of the utmost importance to secure at once an unobstructed outflow of all toxic fluids from the abdomen. It must also be remembered that a drain is likely to affect only a small area; consequently, a number of drains must be used.

The various methods of drainage of the abdomen that have been employed at different times, are familiar to all present. The first really great advance towards

modern methods of abdominal drainage was outlined in a paper read by Dr. Murphy at the Atlantic City meeting of the American Medical Association some years ago.

Murphy at that time reported 16 cases of appendicitis with peritonitis, with 15 recoveries. His paper was accepted with marked reservation, and it was only after years of experience that we realized that his ideas were in the main correct. He advocated the Fowler or sitting position, and the use of normal saline by proctoclysis, so as to convert, as he said, the peritoneum from an absorbing to a secreting surface.

Dr. Murphy considered the Fowler position of first importance because it allowed all fluids to gravitate into the pelvis, where the activity of the lymphatics is not so great as in the region of the diaphragm. By keeping the patient in an elevated position all fluids are thus brought into the pelvis, and enabled to escape more readily by means of a drain, placed in the cul-de-sac of Douglas. The lower rate of absorption in this region allows more time for the peritoneum to dispose of all poisons that are not expelled through the drain.

The greatest factors in abdominal drainage are gravity, intra-abdominal pressure, and capillary attraction. Of these, undoubtedly, the most important is gravity, the full value of which we do not believe has always been secured.

There are three definitely recognized positions used in treating these cases, and each seeks to secure to the utmost the influence of gravity. These positions are (1) the Fowler position as advocated by Fowler and, later, by Murphy; (2) the prone position, or what is known as ventral decubitus; (3) the lateral position, where the patient is placed on the side.

The Fowler position is the one most commonly em-

ployed throughout the country. It has a number of disadvantages that must be taken into consideration. As Coffey has shown, it is necessary to raise the patient so that the long axis of the abdominal cavity is at an angle of sixty to seventy degrees to the horizon, before the spaces in front of the kidneys will drain into the pelvis. This position tends to throw a decided strain upon a patient with an already weakened heart and lowered blood-pressure. Furthermore, this position favors gastric distention with its associated ill results. Moreover, in the Fowler position the pelvis is lower than the pubic bones, and the escape of pus takes place by syphonage.

In regard to the prone position: Some years ago one of the resident staff of the St. Louis City Hospital made the observation that he thought if a patient were placed on the abdomen, drainage would be more effectual than in any other way. The plan looked feasible, and was tried out so successfully that a number of the staff now use it as a matter of routine. As it is now carried out the patient is placed on the abdomen, usually for from twenty-four to forty-eight hours, with the head of the bed elevated about ten or twelve inches, a pillow is placed under the lower part of the chest, and one under the head, so as to give the patient ample room to breathe. The principal objection to this position is, that it is not comfortable. Our observations lead us to believe, however, that it is not nearly as uncomfortable as one would suppose.

By this position we get the maximum effects of gravity, intra-abdominal pressure, and capillary attraction. In addition to this there are no spaces in the front of the abdomen to favor the formation of pockets, as there are in the pelvis and alongside of the spine. The pus is also brought against an area of the abdomen, where blood-vessels and lymphatics are not

nearly so numerous as they are in the pelvis. We believe this to be a very important factor, as it would seem that absorption would take place more slowly here than in any other part of the abdomen.

The lateral position, in which the patient is placed on the right side, we have found to be very efficient. In this position the head of the bed is slightly elevated (about 30 degrees), and a pillow is placed under the region of the liver so as to prevent any room for accumulation of fluid in the kidney region. The patient is turned over far enough so that pus will drain from in front of the left kidney. In a series of interesting experiments on the cadaver, Dr. Coughlin has shown that this posture when properly employed will probably allow a more complete escape of fluid than any other.

In an analysis of 104 drainage appendix cases that have been operated on at the St. Louis City Hospital during the last year and a half, I find that the three positions have been employed with sufficient frequency to warrant us in drawing some conclusion as to the relative merit of each.

In a series of 15 cases, treated in the lateral position, there was an absence of mortality. Of these 15 cases there was one of an eight months' pregnancy with ruptured gangrenous appendix and peritonitis; there were 6 cases of acute appendicitis with perforation; 4 cases of appendiceal abscess; and 4 cases of acute appendicitis.

In a series of 42 drainage cases treated in the abdominal position, there were but 2 deaths. An analysis of this series shows that in 11 cases localized abscesses had formed; 19 are recorded as cases of perforated appendicitis; and in addition to this there were 5 cases in which general peritonitis had developed; 7 cases were cases of acute appendicitis, and of these all but 1 were gangrenous or suppurative.

In the 47 cases treated in the Fowler position, there were 5 deaths. An analysis of this series shows that there were 10 cases of appendiceal abscess; 7 cases of perforated appendicitis with general peritonitis; and 8 cases of ruptured appendix. There were 17 cases of acute appendicitis and 1 case was an acute appendicitis with pelvic peritonitis. There were 2 cases of chronic appendicitis (evidently recurrent cases); and 1 case with cholecystitis is recorded. There was 1 case of general peritonitis with abscess of the liver, and 1 case is listed as progressive peritonitis.

In the treatment of these cases, peristalsis is controlled by the use of opiates, and absolutely nothing is given by mouth. The necessary water is introduced into the system by the Murphy method.

Formerly we used normal saline, but, in view of the fact that salt puts some strain on the kidneys, we now use a solution of glucose and soda. Glucose is a carbohydrate of high caloric power that is easily burned off in the system, and tends to keep up the strength of the patient. The soda is added because of the tendency to acidosis that follows all severe cases. Formerly, we used bicarbonate of soda, but lately we have been using the citrate. The strength of the solution is 3 per cent glucose, and 2 per cent soda solution.

The materials used in drainage of abdominal cases, I believe to be important. Formerly, glass tubes were employed, but it was found that they had two distinct disadvantages: (1) they were hard, and would tend to ulcerate through the bowel and form a fistula, if left in too long; (2) they have also been known to break off inside of the abdomen. This happened in a case of my own in which I operated upon a colored man for five perforations of the small intestine caused by gun-shot. The peritoneum was opened, the per-

forations repaired, and a glass tube inserted into the pelvis. A few days later in removing the glass tube, I found that it had broken off, and a part of the tube, almost two inches or more, was left in the abdomen. This necessitated a further operation, which, fortunately, was successful, and the patient recovered. At the present time we prefer a large slit rubber tube, with a small wick in it, with one or two additional drains of rubber dam wrapped around a piece of gauze after the plan suggested by Robert T. Morris, of New York.

In conclusion, I wish to state that I believe posture to be an important factor in the recovery of the severe cases of abdominal drainage. At the same time the whole after-treatment is of the greatest importance, and the position alone will be of no avail unless the giving of food by the mouth is strictly prevented.

In fact the principles of the so called Ochsner treatment should be most vigorously applied after operation if we are going to secure the best results in these very interesting and but too often desperate cases.

In closing, I wish to emphasize the fact that the series of cases reported here came from a stratum of society where personal neglect is the rule.

Many of these patients were poorly nourished and sadly neglected, and they entered the hospital only as a last resort. If we take these facts into consideration, and then remember that there were only 2 deaths out of 57 cases treated in the prone position and on the side, I think you will infer, not only that the record is an excellent one, but that the posture in which the patients were placed contributed materially to their recovery.

CASES IN DETAIL

CASES IN DETAIL

No.	Name	Age	Diagnosis	Duration of Illness	Drains	Post-Op. Care (position)	Result
9116	V. R.	24	Append. abscess	4 days	6 Gauze	Fowler	Pain
8948	R. G.	22	Rt. pyosal.-Ac. append	7 days	1 Cigarette	Fowler	Healed
9183	L. B.	39	Perf. append.-Abscess	9 days	2 Ido. Gauze	Fowler	Healed
8834	P. S.	18	Acute gang. append	4 days	1 R Dam	Fowler	Healed
7629	W. G.	20	Acute perf. append	1 day	1 R Tube	Fowler	Healed
13816	G. M.	27	Acute supp. append	2 days	1 Cigarette	Fowler	Healed
13608	J. F.	14	Perf. append.-Gen. per	3 days	2 R Dam	Fowler	Healed
13910	G. S.	26	Gang. appendix	3 days	1 Cigarette	Fowler	Healed
14018	W. G.	20	(Perf. append.) Periton	2 days	2 Cig.-1 R Tube	Fowler	Healed
13274	N. G.	15	Acute append	2 days	1 Cigarette	Fowler	Healed
10094	R. D.	27	Append. abscess	10 days	2 R Tube-1 Gauze	Fowler	Healed
7931	A. S.	20	Rt. sal.-Acute append	2 days	1 R Dam	Fowler	Healed
5587	J. S.	16	Acute gang. append	5 days	2 Ido. Cigarette	Fowler	Healed
5294	O. B.	10	Accute append.-Periton	3 days	3 Drains	Fowler	Died
4904	E. R.	33	Chronic appendicitis	2 days	1 R Dam	Fowler	Healed
4372	A. M.	57	Chronic append.-Cholecystitis	10 hrs.	1 R Tube-1 R Dam	Fowler	Healed
2809	O. F.	16	Acute append.-Abscess	4 days	2 R Tube	Fowler	Healed
15125	C. K.	13	Gang. perf. append	3 days	1 R Tube-1 Cig.	Fowler	Healed
16040	J. S.	22	Gang. perf. retro-append	3 days	3 R Dam	Fowler	Healed
197	W. S.	25	Ruptured append.-Peritonitis	3 days	3 R Dam	Fowler	Died
1410	R. W.	21	Acute perf. append.-Gen. periton	3 days	2 R Dam-1 R Tube	Fowler	Healed
7031	B. M.	45	Acute perf. append.-Abscess	10 days	2 Cigarette	Fowler	Healed
8752	M. C.	40	Append. abscess.-Periton	10 days	1 Cigarette	Fowler	Died
7647	J. W.	48	Gangrenous append	3 days	3 Drains	Fowler	Healed
7219	O. D.	9	Gangrenous append	3 days	1 R Dam	Fowler	Healed
	W. R.	45	Progressive peritonitis. Append	2 days	3 R Dam	Fowler	Died
7189	M. Y.	22	Append. abscess	2 days	3 Drains	Fowler	Healed
7113	H. C.	23	Acute append	2 days	1 R Tube-1 R Dam	Fowler	Healed
2623	C. B.	53	(Gen. per.)-Abscess of liver. Append	3 weeks	1 R Tube	Fowler	Died
6713	B. E.	18	Gangrenous append	2 days	1 R Dam	Fowler	Healed
5789	C. C.	8	Append. abscess	6 days	1 Cigarette	Fowler	Healed
4683	J. N.	35	Rupt. retro-appendix	3 days	2 Cigarette	Fowler	Healed
5970	J. O.	14	Gangrenous appendix	1 day	1 R Dam	Fowler	Healed
5777	B. W.	30	Acute pelvic per.-Ac. append	2 days	1 Cigarette	Fowler	Healed
5236	D. W.	18	Acute gangrenous append	3 days	1 R Dam	Fowler	Healed

CASES IN DETAIL—Continued

No.	Name	Age	Diagnosis	Duration of Illness	Drains	Post-Op. Care (position)	Result
3665	L. O.	49	Supp. appendicitis	7 days	2 R Tube-1 R Dam	Fowler	Fecal fistula
	J. M.	50	Append. abscess	13 days	3 Drains	Fowler	Healed
3694	A. S.	23	Ruptured appendix	4 days	1 Cigarette	Fowler	Healed
4384	F. B.	10	Perf. append.-Gen. per	2 days	1 R Dam	Fowler	Healed
3701	C. R.	25	Acute append.-Pelvic per	2 days	2 R Dam	Fowler	Healed
2647	R. S.	35	Acute appendicitis	1 day	2 R Dam	Fowler	Intest. Obst.
15487	G. S.	31	Appendiceal abscess	2 weeks	1 R Dam	Fowler	Healed
1180	F. F.	22	Perf. append	2 days	2 R Dam	Fowler	Healed
1119	J. K.	24	Ruptured append	2 days	2 Cigarette	Fowler	Healed
1259	D. I.	19	Ruptured append	3 days	2 Cigarette	Fowler	Healed
225	R. A.	24	Ruptured append	2 days	3 R Dam	Fowler	Healed
17034	C. R.	25	Ruptured append	3 days	3 R Tube	Fowler	Healed
1960	E. S.	16	Append. abscess	4 days	1 Cigarette	Abdomen	Healed
2337	M. P.	32	Append. abscess	2 weeks	2 Tube R	Abdomen	Healed
16666	A. S.	23	Perf. append	2 days	2 Rubber D	Abdomen	Healed
15850	F. H.	33	Append. abscess	3 days	2 Cigarette	Abdomen	Healed
3114	M. B.	10	Perf. append	3 days	2 Cigarette	Abdomen	Healed
4070	S. S.	19	Supp. Append	3 days	3 Cigarette	Abdomen	Healed
3697	V. C.	13	Gang. append	3 days	3 Cigarette	Abdomen	Healed
3931	T. N.	36	Perf. append	2 days	2 R Tube, 1 R D	Abdomen	Healed
4080	J. A.	30	Perf. append	2 days	3 R Dam	Abdomen	Healed
5255	C. M.	28	Perf. append	2 days	2 R Dam	Abdomen	Healed
5293	B. W.	19	Perf. append	2 days	2 R Dam	Abdomen	Healed
6988	H. D.	15	Perf. append	1 day	1 R T, 2 R Dam	Abdomen	Healed
10237	C. W.	22	Gang. append	1 week	2 Cigarette	Abdomen	Healed
11728	L. C.	10	Perf. append	6 days	3 R Dam	Abdomen	Healed
12509	F. L.	12	Append. abscess	6 days	2 R Dam	Abdomen	Healed
13796	H. H.	18	Perf. append	3 days	2 R Dam	Abdomen	Healed
11150	E. A.	12	Append. abscess.- G. P.	3 days	4 Cig., 2 R T	Abdomen	Healed
14573	E. D.	15	Perf. append.-Gang	3 days	2 Cigarette	Abdomen	Healed
16660	C. D.	32	Ac. supp. app.-G. P.	2 days	1 Cig., 1 R T	Abdomen	Died–6 days.
8121	G. F.	8	Supp. append	10 days	2 R T, 1 R Dam	Abdomen	Healed
8393	K. B.	30	Gang. perf. append	11 days.	1 Cigarette	Abdomen	Healed
7775	N. T.	35	Gang. perf. append.-G. P.	3 days	2 R Dam, 1 R T	Abdomen	Healed
7519	J. M.	24	Gang. perf. append	6 days	3 Cigarette	Abdomen	Healed

CASES IN DETAIL—Continued

No.	Name	Age	Diagnosis	Duration of Illness	Drains	Post-Op. Care (position)	Result
6547	S. L.	27	Gang. perf. append.-G. P.	2 days	1 Cigarette	Abdomen	Healed
6987	L. B.	13	Acute perf. append	1 day	1 Cig., 1 R Tube	Abdomen	Healed
5795	K. S.	27	Ac. sal.-ac. append	6 days	3 R Tubes, 2 R Dam	Abdomen	Healed
6027	L. K.	38	Append. abscess	7 days	2 R Tubes	Abdomen	Healed
5767	R. W.	42	Append. abscess	14 days	3 Cigarette	Abdomen	Healed
4282	C. E.	12	Perf. append	4 days	3 R Dam	Abdomen	Healed
2752	S. B.	21	Append. abscess	5 days	3 R Dam	Abdomen	Healed
3324	R. W.	24	Ruptured append	2 days	2 R Dam	Abdomen	Healed
2845	A. F.	41	Ac. perf. append	4 days	2 R Dam	Abdomen	Healed
3356	A. G.	25	Ac. perf. append	3 days	2 R T Drains	Abdomen	Healed
1787	E. D.	24	Append. abscess	3 days	2 Cig., 1 R T	Abdomen	Healed
3092	C. L.	13	Acute append	2 days	1 R Dam	Abdomen	Healed
2859	W. M.	40	Append. abscess	2 days	2 R Tube	Abdomen	Healed
16804	M. C.	10	Perf. append.-G. P.	3 days	2 Cigarette	Abdomen	Healed
2753	C. M.	40	Append. abscess	3 weeks	3 R Dam	Abdomen	Healed
971	F. K.	13	Perf. append	3 days	2 Cigarette	Abdomen	Healed
16715	A. F.	24	Gang. append	1 day	2 R Dam	Abdomen	Healed
16683	W. G.	18	Ac. gang. perf. append	1 week	2 Cigarette	Abdomen	Healed
16647	E. R.	21	Ac. perf. append.-G. P	2 days	3 Cigarette	Abdomen	Healed
15848	G. G.	22	Rupt. append	3 weeks	2 R Dam	Rt. Side	Cul de sac ab.
826	E. M.	18	Append. abscess	2 days	2 R Tube	Rt. Side	Healed
2941	C. T.	12	Append. abscess	7 days	1 R Dam	Rt. Side	Healed
15849	J. H.	32	Pus appendix	3 days	1 R Dam–2 Gauze	Rt. Side	Healed
3020	A. H.	30	8 mo. preg.-ac. perf. append.-P	1 day	3 R Dam	Rt. Side	Healed
4568	P. M.	46	Append. abscess	4 days	2 R Dam	Rt. Side	Healed
5065	R. G.	16	Append. abscess	3 days	1 R Dam	Rt. Side	Healde
5279	J. A.	19	Acute append	17 days	1 Cigarette	Rt. Side	Healed
8911	E. P.	32	Acute append	2 days	1 R Dam	Rt. Side	Healed
7994	M. B.	38	Chronic append	4 days	1 R Dam	Rt. Side	Healed
10575	E. F.	19	Supp. append.-P.	4 days	1 Cigarette	Rt. Side	Healed
7573	M. T.	16	Perf. pus append	4 days	2 Cigarette	Rt. Side	Healed
7049	E. C.	14	Gang. perf. append	3 days	2 Cigarette	Rt. Side	Healed
6073	R. B.	13	Acute append.-Gang	7 days	1 R Dam-1 R Tube	Rt. Side	Healed
8403	J. S.	24	Ruptured append	2 days	1 R Dam	Rt. Side	Healed

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DISCUSSION

Dr. Wm. T. Coughlin (St. Louis): It has always seemed to me rather strange that the profession has been so long in utilizing gravity to aid in efforts to drain the abdominal cavity. It is a well-known principle that in opening an abscess drainage should be made at the most dependent portion; and the cases Dr. Hill has referred to were not simply cases of appendicitis with abscess, but cases in which the whole abdominal cavity may be said to be an abscess cavity. I do not think the principles of drainage of that cavity should differ from the principles governing drainage of any other cavity. The Fowler position means one thing to one man, and another thing to some one else. To me it means that the head of the bed is elevated from eighteen to twenty-four inches from the floor and the patient is supine. The half-sitting posture is entirely different (so far as we have been able to find out) from the Fowler position as originally advocated. With both of these positions, when the patient is suffering from shock, there is danger of cardiac failure when the head of the bed is raised. This danger is further increased when the patient comes from the operating-room in an already bad condition, and many of these patients go into profound shock. Their resistance is lowered, and even though good drainage be established, the patient often succumbs because of his toxins, and not from shock. The heart gives out because of being poisoned with the toxins while the patient is subjected to the influence of shock. When the patient is suffering from shock, is just the time when the drains are at the maximum efficiency. It has been very clearly shown by Dr. Yates that drains, after the first twenty-four hours, do not drain the abdominal cavity. Up to ten hours they practically all drain regardless of the material used, and it is in the first ten hours we get the best work from drainage. If you want to save the most patients in these cases, either turn them over on the abdomen and increase the pressure in the abdomen by means of pillows under the region of the liver, or turn them on the right side with pillows under the liver, and that will be a sort of treatment for shock, if any exists, and at the same time aid drainage.

Instead of increasing the patient's shock by putting him in the Fowler position, you are overcoming it, and, at the same time, it does not need further demonstration that drainage is better in that position, and all recesses in cavities in the back of the abdomen will empty themselves against the anterior abdominal wall, and the patient is not liable to absorb so much of the toxins as drainage is going on. While the patient is in the right lateral position the head of the bed is to be raised, and in that way the right lateral position is a bad thing if the patient is shocked very much. While the patient is in the lateral position, he has a pillow underneath the side so as to elevate the pocket that is in the region of the left kidney, and keep fluid from getting up towards the diaphragm.

We have found by experiments on the cadaver—and the cadaver is not the same as the living body—that we could drain ordinary fluids out of the abdominal cavity while the patient was in the right lateral position, with the long axis of the body at forty-five degrees to the horizon, and the opening for the drains just above the anterior superior spine of the ilium. That gives the abdomen a slight inclination towards the bed, and that position is more comfortable than if the face is turned entirely towards the bed. It is a fact that in the matter of drainage the spread of pus, the spread of any fluid through the abdominal cavity, is facilitated if brought in contact with the parietes. The fluid travels only along the parietes.

Dr. Hill spoke about the discomfort of the position. Discomfort does not make much difference when a patient is struggling between life and death. These patients do not care what is done the first two hours after the operation, and, for my part, I use morphine very liberally the first twenty-four hours. I give instructions to have the patient *kept quiet with morphine,* and at the same time they get all the water they can take by mouth, if not nauseated, or by rectum, and, if necessary, given intravenously or subcutaneously.

It has been stated that the giving of bicarbonate of soda by rectum counteracts the acidosis present. I did not know why it was these patients did better after giving them morphine until Dr. Crile informed us that he had discovered that the production of sleep immediately after shock or after operations is a very important factor in reducing acidosis. I

think morphine is a good thing to give immediately. I do not give it after twenty-four hours.

As to the position of the openings: I mentioned the position for the opening in the right lateral position. While the patient is drained in the right lateral position, it is only in those cases where the focus of suppuration originates on the right side, generally in appendicitis. In such cases one drain is fastened to the place where I think the trouble began, and that drain is to be left in situ for some days. The other drains are two in number. One goes over the brim of the pelvis to the bottom of the pelvis; it does not make much difference whether it goes to the bottom or goes over the brim of the pelvis to keep the intestines from becoming agglutinated to the posterior or lateral wall of the brim of the pelvis when the cavity of the pelvis may be drained. The cavity of the pelvis is always completely emptied of fluid when you turn the patient on the side and tilt the abdomen toward the bed. A third drain is inserted as far as the liver upward to the right of the ascending colon. The lowest point in the cavity is just at the place where the tubes make their exit through the incision just above the anterior superior spine of the ilium. The median incision is always closed tight.

Dr. F. G. Nifong (Columbia, Mo.): I have an old friend and mentor who has been teaching surgery for many years, and he often reminds his pupils that water will run down hill, or fluid will seek its level. It is not only a plain problem in physics, but an axiom in physics, that fluids will seek their levels and water will run down hill. The only problem then of abdominal drainage is this action in physics modified by certain other physical conditions, such as the convolutions of the intestines, and the attachment of the mesentery across the spinal column, making two lateral cavities.

I am interested in the prone position because it appears to me there seems to be somewhat freer drainage in draining in a direction from the center to periphery; you might say, from the spinal column to the periphery between the folds of mesentery to the outward opening.

The Fowler position and the ordinary means we have been using for some time in establishing abdominal drainage, we all know, are efficient to a great extent. When it comes to general infection we want more drainage than can be established by anterior openings in the Fowler position, and we

must have counter-lumbar incisions. If we have general peritonitis, we want to get efficient drainage. Whether we put patients in the prone position, or leave them on the back or in the Fowler position, we must have three or four openings.

Another advance is made by Dr. Coffey in his so-called quarantine drain when the infection is limited to the lower part of the abdomen and pelvis. Only the day before yesterday I had a case in which I operated, and had pretty general infection of the peritoneum, and with it pus tubes complicated with some fibroids, in which I hesitated because it is advised sometimes to wait for infection to subside. The patient was admitted to the hospital a few days before, and had been sick for ten days with a low-down peritonitis, with a leukocyte count of 15,000, and a temperature of 102° to 103°. The question was whether I should wait a little longer; but more and more, as I get a little older, I am inclined to go after a spreading peritonitis, whether rapid or slow, and make an opening at the point of least resistance. So I operated on this negro woman, and instituted a quarantine drain, described so beautifully by Dr. Coffey (not only one time, but several times, have I used it satisfactorily), and in twenty-four hours the temperature was normal. The drainage was satisfactory, and everything was all right.

I want to commend the Coffey quarantine drain or pack.

Dr. H. B. Sweetser (Minneapolis): I desire to ask Dr. Hill whether there have been any deaths when this position has been used. Two cases of general diffuse suppurative peritonitis have come under my care recently, which impressed me markedly and which possibly might have terminated differently if they had been treated post-operatively in this position. Both were operated on late, that is, in the second and third week. They were placed in the Fowler position, and had rectal instillation of fluid. Both progressed favorably at first, but encysted abscesses occurred between coils of bowel in various position—on the left side, high up, about the sigmoid, and in the pelvis. These were opened when found, but eventually both patients died, and at autopsy other encysted abscesses were found.

I am very glad to have heard Dr. Hill's paper, and I expect to use this method of drainage in such cases in the future.

Dr. A. E. Benjamin (Minneapolis): I was pleased to

hear Dr. Hill's paper because he advocates a position I have been employing in all of my cases of peritonitis, either from pelvic disease or appendicitis, and I must say that I have been more satisfied with it, as my patients also have been, than with the ordinary Fowler position. I have, however, in mild infections first begun with the simple Fowler position, with drainage; and, if then there was not sufficient drainage, with a tendency to distention of the abdomen, discomfort and pain, I would turn the patient over on the face, and it is surprising what results are obtained immediately. It is almost a panacea for dilatation of the stomach. The patients will turn over themselves in this position after they have tried it for a few days.

I recall one case in particular which illustrates the benefit of this position. The patient was a physician whom I operated on two years ago, and who was in a very bad state. His abdomen was very much distended. He had a large abscess, and it did not look as if he would recover. I simply drained. I saw him for the first time and took him to the operating-room immediately. He had been treated by a medical man before that, for several days, who did not know exactly what the condition was. As soon as he was able, the next day we turned him over. We did not remove his appendix because he was in such bad shape and the appendix could not be easily found. About the sixth day the whole appendix sloughed out through the opening. He was much pleased when I told him about it.

Dr. R. C. Coffey (Portland, Oregon): A few years ago I took up the study of drainage, and the question of posture in connection with drainage, soon after the advent of the Fowler position, or before Murphy had given us the sitting posture. We studied the fossæ of the abdomen by making a plaster cast, taking out all viscera except the appendix and the end of the cecum, the gall-bladder, the liver, and the ureters, and along the ureter we pinned a string to identify its position. We filled up the cavities of the body (after leveling it) with plaster of Paris. We cut off the body away from the casts, turned the casts bottom side up, and put sticks across the casts, so that we could saw through the various sticks and various positions. We found that a line drawn from the center of the perineum to the tip of the shoulder would go through the deepest part of the pelvis and through the deepest part of the flank. The appendix

was well towards the front. The flank was four inches deeper than the point of the appendix or psoas muscle, where it rested in the ordinary man. We found by this cast that a patient turned on the right side, and with the head of the bed elevated for six or eight inches, would drain all the fluid out of the cavity. This is a little easier and more comfortable position than the face position Dr. Hill refers to. It ought to be just as successful because it will drain every portion of the abdominal cavity by slightly raising the head and turning the body over to the right side and having the drain at that point.

Dr. Hill (closing): Dr. Coffey will remember that I mentioned that the lateral position has been most effective. I did not know he had worked it out. I am glad to say that Dr. Coughlin demonstrated this position before the St. Louis University class. Of the fifteen cases we have had in this position, there has been no mortality in the series. As a rule, we put the patients on the stomach for a few hours, and then turn them in the lateral position. There are two factors in the use of this position. One is the fact that the drainage is very effectual, and another is the fact that purulent fluids are brought against the nonvascular area of the abdomen.

In regard to Dr. Sweetser's statement of his patients' dying of abscesses: As I pointed out, the front of the abdomen does not contain a number of places where pocketing may take place. You have an area in the pelvis and an area along each side of the kidney and mesentery that favor the formation of pockets. I used to have these patients linger along, and die later, patients that now we never think of losing.

Dr. Benjamin called attention to some very important points when he stated that these patients get such great relief. These patients certainly do better than when they are in the Fowler position. They do not have the gas, and they do not have as much vomiting. In fact, I have seen patients relieved of persistent nausea and vomiting by this position. It has been my experience in the desperate class of cases that we get in our city hospital, that they do not do so well when they are placed in the Fowler as in the prone position, and the mortality is more than twice as high.

I know that there is a certain class of patients we cannot define that used to die when I put them in the Fowler posi-

tion, but now they get well when I put them in the prone position for twenty-four hours, and then in the lateral position.

Dr. Sweetser: What is the result as regards hernia in these cases?

Dr. Hill: That is one thing I forgot to mention. We have not had any more trouble; in fact, we have had less post-operative adhesions this way than from the Fowler position, and the cases of post-operative hernia are no more frequent.

THE BALANCE OF POWER IN INFECTION

Horace G. Wetherill, M.D., F.A.C.S.

DENVER, COLORADO

In certain infections of a more or less chronic type, —tuberculosis, for example,—a warfare is often waged in many different portions of the body at about the same time. The battle may be going fairly equally, or the pathogenic organisms may be having somewhat the better of it. Under such circumstances it is possible for surgery to come to the aid of the defense by eliminating a hopelessly lost field, and so release for duty in other fields forces thus left free to act elsewhere. Surgery brings about what may be called a balance of power for the defense as against the disease.

To illustrate, let me cite an example which has probably occurred to every surgeon of large experience. A patient with extensive general tuberculous infection has some involvement of one or both lungs, tuberculous glands in the neck and mediastinum, and partial or complete destruction of one kidney, possibly with slight involvement of the other. The battle is going against him because upon the whole the forces of the invaders are stronger than the forces of the defenders.

The tubercle bacilli and their allies of the cocci family, forming a mixed infection are securely entrenched in certain strongholds which they have conquered and are engaging a strong force of the defenders who are occupied in besieging them in such positions in order to invest and conquer them.

The balance of power is with the invaders. They have overcome all resistance in certain areas and have occupied the field and destroyed the usefulness of an organ, and from this stronghold are invading other fields and overmastering the resistance, taxed with an ever increasing burden of elimination and immunization. The mere loss of the organ by disease has often been discounted by the economy because nature is so lavish in her provision for such contingencies. The other kidney has taken up the burden of its fellow and is doing its own and the other's work together with the additional burden of increased elimination of its toxins and debris.

The surgeon may throw the balance of power to the defenders when he interferes. Gently and carefully, and at the right time, he attacks the stronghold of the enemy and removes the disorganized kidney with its army of mixed organisms, arresting at once the output of toxins and the diffusion of disease from this focus to the bladder and elsewhere. The defenders are then restored to relative superiority of forces in this and other fields, and the tide of battle is turned in their favor.

We have all seen a re-establishment of balance of power for the defense after operations for the removal of a disorganized kidney, a tuberculous appendix or tubes, or lymph-nodes, and the evacuation of infected pleural or peritoneal effusions. With these experiences in mind we undertake the surgical elimination of such severely infected foci with courage and confidence.

The members of this Association are quite familiar with the splendid work of our fellow, Dr. Emil G. Beck, in pulmonary, pleural, and renal tuberculosis. In discussing with him recently this relative strength

of the pathological invaders and the physiological defenders, and the effect of such surgical operations as have here been referred to, he illustrated the comparative potency of these contending forces and the results of judicious surgery in the following graphic way:

Let us suppose that the disease and resistance may be represented as follows:

BECK'S TABLE

Disease		Resistance
In lungs and pleura	10	8
Glands (cervical and mediastinal)	7	6
Kidneys	10	8
Bones and joints	3	3
Abdominal organs	8	6
Total potency	38	31
Kidney focus eliminated by surgery	10	
Total potency following operation	28	31

This shows a balance of power taken from the disease by surgery, and swung over to the defenders.

Of course the above figures are purely speculative and supposititious. Indeed, it would seem to be very difficult or quite impossible to estimate exactly the degrees of infection and resistance, either locally or generally; but Dr. Beck informs me that he is working towards that end, and hopes to accomplish something in that direction.

My interest in the subject is chiefly in its clinical aspects as presented in the large number of tuberculous individuals coming to us in Colorado, many of whom present multiple foci of infection, some of which are amenable to surgical treatment.

In the consideration of such problems it is very important to formulate a working theory of the way in which results are attained, and then see how far our clinical experiences go in confirmation or refutation of that theory.

Advanced tuberculosis with multiple foci of the disease rarely remains a pure tuberculous infection. Other organisms are engrafted upon and into the damaged tissues and organs; so mixed infections occur in and about many of the primary tuberculous lesions. It is most often in such foci of mixed infection that the necessity for surgical interference arises; and it is also in such fields that judicious surgery may do most for the patient.

Straight unmixed foci of tuberculous infection rarely require or justify open surgical treatment, or, at least, they may often be more successfully treated by other methods. For example, the opening and draining of psoas and other unmixed tuberculous abscesses is now deemed quite unwise. Such foci do better when treated expectantly with rest of the part and aspiration if necessary to relieve pressure, and, if maintained as unmixed foci, often do well. They rarely give rise to severe general or even local symptoms unless a mixed infection supervenes.

Primary tuberculous foci with engrafted streptococcus, staphylococcus, colon bacillus, or other mixed organisms implanted into them, are almost invariably highly dangerous to the patient, and such a focus soon becomes a proper field for surgical interference if the balance of power is to be established for the defenders of the human economy.

Whether this mixed focus be in the lung, the pleura, the cervical glands, the appendix, tubes, peritoneum, or bones and joints, it must at the proper time and under favorable circumstances be gone after with the

knife if the patient is to be saved from chronic invalidism or death.

No more favorable field for carefully considered surgical interference is presented to the surgeon. The results, however, may be brilliant and satisfactory to the last degree, or, upon the other hand, they may be disappointing and disastrous.

So many factors enter as elements of success or failure that it is not too much to say that these substandard risks call for a nicer and finer surgical judgment and skill than almost any other class. Every detail,—the choice of the anesthetic, the temperature of the operating-room, the length of the anesthesia and of the operation, the skill of the surgeon, and the after-care as to nursing, nutrition, and ventilation of the sick-room,—make for success or failure. Nothing, however, appears to be so important as the selection of the right time to operate. Operations during the earlier and more acute stages of most infections are now believed by many surgeons to be most unwise, as dissemination and diffusion of the infection occur, and such a flood of toxins is let loose before the autogenous vaccines have adequately immunized the individual that the end is hastened rather than postponed.

There is a time during which such patients must often be treated expectantly—a time to wait and a time to operate. One must have in mind the danger of interfering with the resistance of the defense and of opening up new avenues to the enemy by untimely and ill-considered surgery.

Many physicians and surgeons of Colorado of large experience elsewhere—for they are a cosmopolitan lot—believe that such cases of surgical tuberculosis, so-called (mixed tuberculous infections in fact), do better before, during, and after operation in Colorado than in the duller, damper, and lower country about us. We

believe that the many days of sunshine, the dry atmosphere, and the altitude are important factors in helping to bring about the good results we so constantly see in these patients with various phases of surgical tuberculosis. Here the autogenous immunization after a carefully considered and executed operation for the elimination of a mixed focus appears to us to create a balance of power for the defense which is prompt and permanent.

The known facts relating to the favorable influence of the Rocky Mountain region on pulmonary and other forms of tuberculosis, and the commonly quoted example of meats cured in the open air in this region without decomposition indicate that there are agencies at work which retard the growth and development of the etiologic, pathogenic, and saprophytic organisms which cause these conditions. That such factors, be they sunlight, dry air, altitude, or what not, are also effective in inhibiting the growth of organisms which cause wound-infection, is believed true by many surgeons who work in this region, and to such causes may be attributed the good results of surgery done for the purpose of re-establishing a balance of power for the defense.

The best results appear to have followed operations for the evacuation and obliteration of cavities containing pus and old pyogenic membranes (the pleural cavity, for example), and the removal of organs the function of which has been greatly impaired or totally destroyed by multiple abscesses, as may be the case with a kidney, a testicle, or even a lung.

The effect of such operations in reducing toxemia and in eliminating a focus from which diffusion of the disease takes place, is at once apparent in the marked improvement of the patient if the time at which the operation is done is well chosen and the de-

tails of the preparation, operation, and after-care are minutely ordered to save time-exposure and exhaustion for the patient, and if he be saved from a long and badly managed anesthetic. The last is a most important item.

Many of the distressing early symptoms, rise of temperature, and toxemia in patients whose tuberculous foci have broken down, are doubtless due to sapremia rather than to a definite mixed infection with pathogenic organisms. Saprophytic organisms readily find access to the damaged tissues about a tuberculous focus, and, invading them, bring about disorganization and decomposition, which produce fever and toxemia. We are all quite familiar with the profound symptoms of saprophytic intoxication caused by a retained bit of decomposing placenta, and we are quite as familiar with the immediate disappearance of the symptoms after the removal of the cause.

The same principle holds true with saprophytism elsewhere, whether it be in a lung, with the stinking putrid breath characteristic of it, a sloughing appendix, or a broken-down kidney.

The removal of the devitalized saprogenic tissue turns the scale in the patient's favor; and his chances for recovery are at once enormously improved.

This is what Dr. Beck would portray with his graphic mathematical tables and what I mean by suggesting that the term "Balance of Power" conveys a clear conception of what may be accomplished by surgery in such conditions as have here been referred to.

DISCUSSION

Dr. Emil G. Beck (Chicago): Dr. Wetherill has found the right term, namely, "Balance of Power in Infection," for the theory on which I have been working for the past eight years, and have partially proven by experiments on animals and also by striking examples in cases which came under my immediate treatment. He has put this theory in such

clear terms before us that I really understand it better than I ever did.

I shall try to illustrate on the blackboard my theory, which is practically a fight between disease and resistance. The chart below illustrates in figures what I wish to explain in words.

Every person or animal born possesses a slight natural immunity against all disease. If any particular disease affects the body, an immunity against that very disease will grow in proportion to the severity of the infection. In other words, the immunity produced in the body will try to keep pace with the progress of the disease. If the disease progresses slowly, the immunizing process will be able to keep step with, and even overcome, the progress of the disease, and thus the patient may have a spontaneous cure. If, however, the disease progresses rapidly and violently, and the system is unable to produce its immunizing substances (antibodies) at the same rapid rate, the person will perish. Thus we may illustrate this theory by a sort of ledger, in which the disease occupies the debit side and the immunity the credit side. Let us designate the quantities of disease and immunity by units. To illustrate this theory: A patient affected with tuberculosis of the right kidney is found to have also a slight affection of the left kidney, a tubercular disease of the bladder, and a slight affection of the lungs, and may have in other parts of the body small foci of tubercular infection.

If we represent, as shown in the table, each of these foci with a certain number of units of disease on the debit side, and credit this person with an immunity which he has gradually developed during the progress of the disease on the credit side, we find that there is still a greater amount of disease than immunity present, and thus he is not entirely cured. If we can artificially or naturally develop a higher degree of immunity in his body and keep the progress of the disease in check, he will be cured.

This margin of needed immunity is furnished usually by placing the patient in the proper surroundings—fresh air, medication, vaccines, etc.—and a great many cases are cured in this way.

It is, however, impossible in many cases to force the increase of the immunity by any means, and the disease gets the best of the patient, and he gradually declines. Let us now see what surgery can do in such cases. Let us take

the same case in which the greater part of the infection was in the right kidney. The patient needs a margin of twelve units of immunity, in order to over-balance the combined units of infection. If we remove the most diseased part of the infection, namely, the right kidney, we remove 20 units of disease and the patient after the operation shows a balance of a surplus of 8 units of immunity, which has the effect of a rapid recovery and an unusual gain in weight.

To further elucidate this in theory, I quote from my book on chronic suppurations, page 114:

"Is it not possible that, through the removal of a large portion of the diseased tissue, our body, which has acquired such high degree of immunity during the gradual development of the disease, is suddenly relieved of the source of a large quantity of toxins, and the existing high degree of immunity is powerful enough to cope with the balance of microörganisms still operating in other parts of the body? In other words, is it not likely that during the development of the disease the degree of immunity keeps pace with the progress of the disease, and that the sudden removal of a part of the diseased tissue leaves the system a sufficient degree of immunity to combat the remaining quantity of disease in the body?"

Some years ago I carried out some experiments on guinea-pigs and small swine. I injected the testicles or the kidneys of these animals with germs of tuberculosis, and after they had developed the disease, I also injected the joints. When the joints became swollen and diseased, I removed the testicles or the kidneys, and most of the animals recovered and kept on gaining in weight thereafter and the joints healed spontaneously, while the control animals from which I did not remove the testicles or kidneys, died of tuberculosis.

Dr. W. D. Haines (Cincinnati, O.): This is certainly a splendid paper, and gives us food for reflection. We are not doing bacteriological work; but the problem is, that we as individual patients either overcome the bacteria or they overcome us. What Dr. Beck said in opening the discussion is the crux of the whole situation. If we can select the proper time, and do the proper thing for the patient, we will meet with success. If we do not, we will probably make a debit instead of a credit of the patient.

The thing that especially appealed to me was the statement with reference to ether pneumonia. I thought of what

the farmer said about that long-necked animal, what he said is certainly true with reference to ether pneumonia. Since we have learned to keep patients on the side, turn them over, and have the nurse watch them so that they do not inspire vomitus or get something in the lung, or the patients are not on the verge of pneumonia when they come into the hospital, we hear less and less of ether pneumonia. I do not think it exists *per se*. One of my teachers said the giving of ether would cure bronchitis. We have a man in Cincinnati at the present time who is following the lead of that man, and has been giving ether for quite a long time in cases of incipient tuberculosis, and he thinks he is getting some results.

Dr. J. D. Griffith (Kansas City): This is one of the most valuable papers that could be presented before any medical society, inasmuch as it touches along lines that are absolutely necessary, particularly in bone tuberculosis, that we deal with. In our orthopedic work, especially, we have been trying for quite a little while in cases of bone tuberculosis, before doing anything, to raise this immunity, and we have succeeded in doing so. It is very necessary to do this if we possibly can. We all know that the blood-count runs low in tubercular troubles, whether it be tuberculosis of bone or tuberculosis of the chest, but where we find it is low in children, youngsters particularly, I have been trying to raise it by the use of two things, and I have been experimenting with them for quite a while, one of which is goat serum in raising the leukocytes, the fighting quality, and the other is pituitrin. Goat serum has been used for some time for this purpose, but I have seen but little in the literature of pituitrin used in this way. Pituitrin in these cases of tubercular bone trouble will raise the fighting quality of the individual or child. It will do it right straight along without troubling the youngster in any way. It does it beautifully.

THE TREATMENT OF LACERATED WOUNDS

Fred T. Murphy, M.D., F.A.C.S.

SAINT LOUIS, MISSOURI.

During the past winter I had the good fortune to have the opportunity, in France, of studying a considerable number of lacerated wounds. Although no new principle in the treatment of these wounds had been introduced, so far as I could see, yet I was so impressed by certain factors influencing the process of repair that I wish to discuss them with the Association. These factors are—

1. The use of prophylactic serum.
2. The time elapsing between the receipt of the wound and the establishing of final surgical treatment.
3. The application of the various types of fixation apparatus.
4. The use of special solutions for irrigations.
5. The coöperation between the dentist and the surgeon.
6. The preservation of loose spicules of bone in compound fractures.

Never before in the history of surgery has there been an amount of material comparable to that to be seen in the hospitals on the Continent and available for such a study, but, abundant as has been this material and careful as have been the observations, opinions expressed in regard to the surgical treatment of these lacerated wounds must be accepted, I think, simply as individual impressions. The field is so great

and the modifying conditions so important that the experience of any single individual must needs be relatively limited. Only such procedures as have met with universal acceptance, such as the prophylactic use of tetanus antitoxins, can be considered at present as essential parts of a general method.

In this treatment of lacerated wounds the fundamental problems are the same as surgery has always had to meet, but in degree surgery has never, in a like number of cases, had to cope with mutilations and infections of such extent. This is due to the fact that never before have such large bodies of men fought against each other for so prolonged periods of time, and also because modern warfare has developed means of destruction which have never before been conceived to be possible. A prolongation of a bloody war by the control of epidemics is an unexpected, perhaps an unfortunate, result of modern scientific methods for the prevention and control of disease. While it may be that the fundamental principles of treatment have in no way been modified by these unusual experiences in the present war, yet in the methods of applying these principles very noteworthy contributions have been made. Experience has confirmed in a most convincing manner the previously accepted opinion that antitetanic serum, given sufficiently soon after the wound, will prevent tetanus. Very rarely, late cases have been observed in the base hospitals, but so perfect has been the system of administration in giving serum that tetanus has played no part as a wound infection. What might have been the condition in all the armies had this contribution of Pasteur's not been available is only conjecture, but if one will read the Memoirs of Baron Larrey, in which he describes the experience with tetanus in the Egyptian Campaign under Napoleon, and will consider the conditions under which

the present war is being fought, the probable results are horrible beyond even the possibility of imagination. With the exception, however, of tetanus, no specific means have been developed of controlling the other infections. Indirectly, the personal care of the soldiers, including baths and fresh underwear, has doubtless exerted a very material effect; more directly have the efficient dressings with iodine in the first-aid packages influenced the results. But no matter what precautions have been taken and what treatment has been given, the wounded arrive at the first-dressing stations with the ever-present surgical problems. These resolve themselves into the immediate treatment for the preservation of life, and then such treatment as may limit the spread of infection and hasten the process of repair. In the latter two classes it seems to me that very essential contributions to surgical knowledge have been made. Unfortunately, it is not possible to maintain permanent hospitals immediately behind the front lines. Were this so, I am sure that the mortality would be materially decreased, and that the resulting loss of function would be so reduced that it would seem almost as if a different type of injury were being treated.

Granted that, in order to provide for large numbers of wounded, transportation to a considerable distance is necessary, yet it should be recognized that, however perfected may be the organization and however intelligent may be the surgical treatment received in transit, the total result of surgery carried out piecemeal is relatively bad. Under such conditions the responsibility is divided. The treatment must be considered as an emergency measure, and there is a necessity of failure to consider the clinical problem in its entirety; also there is the ever advancing infection,—a real horror to every surgeon called upon to treat these

cases. This is dramatically demonstrated by a comparison of the ward of a hospital, such as at Compiegne or LaPanne, within a few hours of the front trenches, with those of a base, such as the American Ambulance at Neuilly, where cases are received days or weeks after the injury. Bacteria thrive upon devitalized tissue, particularly the bacillus capsulatus aërogenes. Theoretically, the mechanical sterilization of the lacerated wounds, as advocated especially by Tuffier, would be ideal,—that is, if the devitalized tissue could be cut away and the wound at the same time cleaned with some non-irritating if not bactericidal solution, the remaining tissue would be in the best possible condition for repair. Practically, such mechanical stimulation is limited by anatomical and functional considerations. This method of mechanical sterilization, however, is the only efficient one applicable to the emergency treatment of cases.

In transit the patient must be made as comfortable as possible, and further trauma limited by proper fixation and support of the laceration. The ingenuity of this apparatus for comfortable and safe transportation beggars description. All of it depends upon one of two fundamental ideas: either the application of strong but light metal frames, or the use of plaster of Paris supplemented by bridges made by incorporating steel bars in the plaster, thus affording support and, at the same time, making it possible to dress the wounds en route. By either method of fixation properly applied, further laceration of the tissues is prevented, surgical shock is minimized, and the comfort of the patient maintained to a remarkable degree. Also by such an adequate support of the lacerated tissue, the extent of the resulting defect is surprisingly decreased. In the perfection of these methods of sup-

port for transportation, an essential contribution to surgery has been made.

When the patient has arrived at a base hospital, where it is possible to plan for and carry out routine surgical treatment for an extended period of time, the extent of fixation apparatus has again to be considered. Most of this apparatus falls into two classes: that in which the balanced sling attached to an overhead support is used, and the plaster-of-Paris splints constructed with steel supports as for the transportation. I would not be so dogmatic as to the use of plaster-of-Paris splints. They have been used successfully in certain clinics, but to use plaster-of-Paris successfully requires a degree of intelligence, and an experience which is more than that possessed by the ordinary hospital staff. The pitfalls, such as concealed infection, inability to reach and control secondary hemorrhage, and pressure-sloughs are great. It has many disadvantages, and no advantages over the sling splints. In the use of these sling splints no new principle has been introduced. The Hodgen splint for thigh fractures made use of the sling principle and, at the same time, gave extension; but in the detailed application of this principle a degree of perfection has been attained which is remarkable. These splints will be introduced and used, I am sure, in civil practice because they accomplish all that the older type of apparatus did in the way of fixation and, at the same time, materially increase the accessibility of the wound, as well as increasing the comfort of the patient. Without some such device it is not possible to conceive of the prolonged treatment of these extensive lacerations and infections.

On arrival at the hospital, perhaps before, the battle with infection must be begun. If the hospital can be reached in the first few hours, the infection has not

had time to infiltrate the tissues; the general condition of the patient is depleted only by the immediate effect of the injury; and the problem is relatively an uncomplicated one. Where the patients are received days or weeks after the injury, the picture is complicated by the presence of infections which are so extensive that they bring almost a new problem to the surgeon. Again, the fundamentals of treatment are unchanged. Tension must be relieved, and proper drainage established. Through the studies of Taylor and from the large practical experience of many observers the treatment of gas-bacillus infections has been reduced to very simple essentials. They are to relieve tension, and to remove, so far as possible, devitalized tissue. Since this organism grows only under anaërobic conditions and on devitalized muscle the process may be sharply limited, provided the diagnosis has been made before the muscle has been too badly damaged by strangulation, and if by sufficiently free incisions the tension over the infected area is completely relieved. The injection of oxygen and the use of hydrogen peroxide to change the anaërobic conditions may be theoretically indicated, but practically their efficacy may be questioned.

Failing to find a specific serum for the control of infections, surgeons and investigators have turned their attention to the preparation of some bactericidal solution which may be used for irrigation. We all recognize chemical sterilization of tissues to have been up to the present a failure, because a chemical sufficiently strong to be an active bactericidal agent injures the living cells. Dilute solutions of quinine, iodine, and alcohol have been used, but the effect on the process of repair has not been noteworthy. Influenced by Sir Almoth Wright, many of the British hospitals have employed hypertonic salt solutions.

Flint and his co-workers at Passey believed that they were obtaining unusually satisfactory results from the use of gential violet solutions. Generally, however, normal salt solution has been used because it does not irritate the tissues and by irrigation the wound is mechanically cleansed. Through the experiments and the brilliant clinical results obtained by Dr. Carrel at Compiegne with the so-called Dakin's solution, which is a specially prepared solution of sodium hypochlorite, this has been accepted more generally perhaps than any other special solution for the irrigation of lacerated wounds. In the old Labarraque's solution and eau de Javelle, free caustic alkali remains. The Dakin's solution, when properly prepared, is free from caustic alkali. This solution has been accepted by such conservative observers as Dr. Tuffier and Dr. DePage as having almost specific bactericidal action, and a great stimulating action on the proliferation of tissue. The application of this solution according to the method of Carrel differs materially from the method which has been employed with other irrigations. Not only should the wound be washed with the solution, but, ideally, the tissues should be saturated. In consequence the ideal condition for application is a closed cavity which may be filled at such intervals as the surgeon may determine, and in which all parts of the cavity will come in contact with the irrigating fluid. This necessitates, in the first place, the readjustment of our old ideas of drainage, as well as perfecting an elaborate technic, both as it effects the tubes, which are inserted in the wounds, and also the detailed care with which the solution is introduced by the attendant. The progress of sterilization should be followed by the examination of smears made from the wound; when the smears are no longer positive, or when the number of organisms has been so reduced as to be negligible, the wound may

be closed by secondary sutures or approximated by adhesive straps.

Whether the use of this solution tends to increase the danger of secondary hemorrhage may be debated. Irritation of the skin, at least, in large measure, may be attributed to imperfectly prepared solution or to imperfect technic. After the analysis of a large amount of material which has been treated under all possible conditions by these various methods it will doubtless be possible to arrive at something like definite and sharp-cut conclusions. Brilliant as have been the results obtained at various clinics through different technical methods, the influence which certain possible factors may exert, such as the time at which cases are received after being wounded and the continuation of uninterrupted, intelligent care must not be overlooked.

By the coöperation of the surgeon and the dentist a most important principle has been established. For us in America this may not seem to be revolutionary, but abroad it has broken down barriers that were considered insurmountable. During the early period of treatment in lacerated wounds of the jaw and face, nothing is possible surgically except to support the lacerated tissue to prevent displacements with their resulting permanent contractures in so far as it is possible. The surgeon or dentist working alone is handicapped. The dentist needs the sound judgment of the surgeon in deciding questions of major operative interference, but the surgeon needs, just as surely, the dentist in the application of prosthetic appliances for the support of the bony framework and the preservation of the teeth. By this combination the most remarkable results have been obtained. Through the proper care of the teeth and the preservation of all possible fragments, a bony framework has been made

available for the later plastics, without which it would have been absolutely impossible to have obtained either these results cosmetically or the functional results. I cannot emphasize too strongly the importance of this combination of surgeon and dentist in treating these special lacerated wounds.

Remarkable as has been the ingenuity that has been displayed in devising splints for the support of extremities, no less remarkable has been the development of these prosthetic appliances. Whether the fixation be obtained by wiring the jaws together, by cemented bridges, or by elastic supports, in order that the physiological movement in the approximation of the teeth may be present, the resulting satisfactory repair has been obtained in cases which at the first inspection seemed absolutely hopeless.

The temptation to remove fragments of compound fractures and to "smooth off" the ends of the remaining bones, is all but irresistible. By so doing the surgeon, unquestionably, removes a large amount of material from the wound which may later have to be discharged as a foreign body; and by cutting off the shafts he may prevent further serious injury to the soft parts. In no other group of cases were the effects of sound and unsound treatment shown so dramatically as in the large series of compound fractures of the extremities which it was my privilege to observe. A comparison of the different fundamental ideas in the treatment of these cases was possible because patients were received, by transfer, from other hospitals in which the primary surgical treatment had differed radically. In a very considerable series of cases in which large defects of the bone had followed extensive lacerations, almost without a single exception the bony repair had ultimately led to the formation of a weight-bearing shaft, provided that the spicules of

bone had not been removed together with the splintered portions of the shaft fragments. Many of these bone spicules are later discharged as sequestra. By their presence the final closure of the wound may be delayed, but if they are removed with any degree of thoroughness, non-union will result. Some influence on bone-production is exerted by these spicules, whether or not they are attached to periosteum or whether or not they remain viable. An appreciation of the bone-forming properties of the periosteum has given us results in the treatment of osteomyelitis which are a great improvement over any results previously obtained; but the attempt to carry this principle into the treatment of compound fractures has in these extensive bone-destructions done untold harm. The lacerated and traumatized periosteum, unsupported for any considerable extent by the bone spicules, will not reproduce bone. No matter how detached the fragment may be, it should never be removed at the time of the primary surgical treatment. Smoothing off of the irregular ends of the shafts is indicated only to prevent a further laceration of the soft parts.

DISCUSSION.

Dr. M. B. Clopton (St. Louis): There are two points in this paper I wish to speak about. The first is the question of the application to civil practice of those principles that we have become fairly familiar with at the American Ambulance, particularly in those cases of shattered bones where the fragments seem as though they are going to be of no use. These fragments should not be disturbed. One must remember all these cases are badly infected, the gas bacillus and other organisms being recovered in a large proportion of the cases. About 75 per cent of the cases gave positive gas bacillus cultures, and in 30 per cent of these there was an active gas-bacillus infection, so that the first efforts were directed to a drainage of the wound. Those cases that had all the bone taken out got over their infection quicker, but they had deformities that necessitated long invalidism, and the repair was accomplished only after many

subsequent operations. On the other hand, if bone fragments are left in place, and drainage is done efficiently, they will repair very rapidly; in fact, sometimes they appear to repair more rapidly than non-infected fractures. Whether this is due to the irritation of the bacterial toxins or not, it is hard to say; but cases of fracture of the humerus, which certainly in general experience have been the hardest to deal with, have seemed to give very much quicker and better results, if they were open infected cases, than if perfectly clean closed fractures.

The next question that comes up is the one of the type of irrigation of these wounds and the character of the dressing. It certainly appeared to us that the different fluids were efficient only as far as they were properly applied. At that time the various divisions of the hospital used different kinds of fluid. The man who looked after the cases was the most important factor, and the dresser who had charge of the work really determined the results as much as anything else. I wish to say that some of the best work that was done with these fluids was done by Dr. Kenneth Taylor, who is from St. Paul, I believe, and Dr. Taylor's work is the work that was referred to last night by Dr. Albee as being done by a woman. The credit of all bacteriological work done for Dr. Blake at the American Ambulance is due to Dr. Taylor.

Dr. Emil G. Beck (Chicago): It is very fortunate that prominent American surgeons have found it worth while to go to Europe to gather experience in war surgery and to teach us something of what they have learned, and thus give us the opportunity, not only to fortify ourselves for the future, but also to employ the same principles which they have carried out in war surgery in our practice here.

My brother, Dr. Carl Beck, has organized five Units, which he sent to Germany last year, and among them is Dr. Eastman, a member of this Association, who reports on the wonderful work that is being done in Austria, and who will no doubt tell us something about it at the next meeting.

Dr. Richter has come back, and he recently made a report in Chicago of seven hundred or more cases of fractures which he had treated, most of them being compound fractures and infected. They were treated by the most simple methods, and the results are beyond expectation. There was only 2 per cent mortality in these extensive injuries, similar to those here shown on the screen.

I wish to say that my brother is organizing two more Units now; and he has authorized me to say if there are any surgeons contemplating taking up such work, he would like them to communicate with him.

One thing that struck me in all the pictures I have seen in Chicago recently and here today shows the open method of treatment. They use hardly any sutures, which fact I mentioned yesterday in connection with the cases I exhibited. I did not use any sutures in those cases. I believe the time is coming when infected cases, such as amputations of the shoulder for sarcoma, where the wounds are suppurating, will be handled in such a way that no attempt will be made to close the wounds at all, but simply to put on moist dressings, or even leave them exposed and allow them to granulate and later on make some transplantation of skin when the condition of the patient will warrant it.

Dr. Henry T. Byford (Chicago): I would like to ask a question. If these bone spicula or particles of bone are left entirely disconnected with tissue, do they undergo necrosis? I would like to ask, now, whether they wash out the loose pieces or leave them for attachment to the tissues or fascia, and whether some of the spicula of bone that are entirely without connection will remain alive and become part of the new bone structure?

Dr. C. H. Lemon (Milwaukee): It should be remembered that at the close of the Civil War, surgery had attained a high degree of efficiency. In fact, it was the Civil War that gave us Buck's extension. The principle of extension in the treatment of fractures had not been understood prior to that time.

The pictures shown by Dr. Murphy are the most interesting that I have seen. They are both interesting and instructive because they have been selected with great discrimination and show how often the apparently hopeless case can be treated successfully by the use of ingenious devices. It is my experience that when one understands the use of plaster of Paris, more can be done towards saving limbs which are apparently hopeless than can be accomplished by any other method of fixation, because, in these badly lacerated and comminuted cases, without absolute fixation infection becomes insurmountable, and amputation has to be done later on. In the pictures here shown, you must have noticed how very well the plaster of Paris was used.

Some years ago, in one of my trips to Europe, I found that the Austrians and the French excelled in the use of plaster of Paris, whereas in Northern Germany and in England they seemed to know little or nothing about it. On one occasion, while conversing with Mr. Lane, I asked him why he did not use plaster of Paris, and he asked me what it was. I learned from him that during the twenty-five years he had been treating fractures at Guy's Hospital, he had never once used plaster of Paris.

I have never seen so many ingenious devices used for the treatment of fractures of the extremities, as are shown in Dr. Murphy's pictures, and I am sure we are all under obligation to him for the discrimination he has shown in selecting these cases for presentation to us.

Dr. H. E. Pearse (Kansas City): I would like to ask Dr. Murphy whether extension is applied in the building up of these plastic posts?

Dr. Murphy (closing): I will first take up that part of the discussion which deals with gas-bacillus infection. The studies of Taylor have reduced the treatment of gas infections to a simple procedure. The gas-bacillus lives only on devitalized muscle. It is a vicious circle. The muscle is first devitalized by trauma, and as gas is formed it is further devitalized by the tension of the fascia. If that tension is relieved by early and extensive incisions, then the gas-bacillus infection very early becomes limited. Whether Dr. Hopkins' cases were of that type, I do not know. Personally, I have had no experience with the treatment he mentioned. Where these cases are obtained early, the gas-bacillus is no longer very much dreaded by the men doing war surgery. It is the later cases, when the muscle has become further strangulated. Tuffier formulated his idea of mechanical sterilization particularly on that basis, holding that the first treatment should be very extensive incision, including the removal of all detritus about the wound. That has very definite anatomical limitations. If it were possible to carry it out, it would limit absolutely the question of infection.

Dr. Byford brought up the question of necrosis, that is, whether these bone fragments live or die. I know of nothing more tempting than to let a man put his finger into a mass of fragments; he is sure to take out some of them that would eventually live. It seems to me that the only safe rule is to take none of them out. If they are inclined to

drop out, poke them back in, and hold them in with a dressing. If they insist on coming out with suppuration, all right; but, whether they remain vital or not, they do have an influence on bone-production. We are now carrying out a series of experiments by the use of a simple dye, introduced intravenously, at the laboratory, showing the way in which these spicules do influence bone-production, and it is very striking. I should say, never take them out, whether loose or not, inasmuch as they do influence later bone production.

Dr. Lemon raised a question with reference to the use of plaster of Paris. I would not argue the question of the use of the plaster as compared with these splints, that is, splints that are used where the wound can be left open. The Harvard Unit published a report of their experiences. They believe plaster of Paris is a good thing. As a matter of fact, however, shortly after they were relieved of their responsibility at the American Ambulance, and were displaced by other men, splints were substituted in the place of plaster of Paris. Plaster of Paris used by the experts and very carefully followed does give fixation, but it does have great danger associated with its use. Nothing, I think, can give as absolute fixation as the plaster.

In answer to Dr. Pearse's question about building up the arm and shoulder, the principle was the same there as it is carried out by those who have worked with cases of paralysis from poliomyelitis involving the upper extremity. There is the same principle of fixation of the arm and the shoulder-joint, and getting abduction from the scapula. The whole trick of this brace is that the weight should be borne by the crest of the ilium and the side of the pelvis. The post from the crest of the ilium is supported, and in these wounds, with destruction of the upper extremity of the humerus, abduction may be brought about to a very marked degree, and a useful arm is the result, whereas if they are allowed to ankylose by the side, that motion of abduction is lost.

Dr. Pearse: Is the post made of plaster?

Dr. Murphy: Of metal or a metal support. The lighter dressings were made in stock. These cases come to the hospital in such large numbers that you have no idea how many of these things are needed. Mr. Jones was so impressed with the idea that he was going to take some of the models to give to the English bases. They are made in large num-

bers, so that they are applicable for a suppurating wound, not only through the shoulder, but for wounds of the femur.

Just one other point which has not been brought up, and that was as to later interference in these cases. Certainly, it was the experience of all men operating about Paris that we had to wait many months before the wounds seemed to be in a condition for re-operation, and then you had to wait many months before you were able to operate and not run very serious risks of re-infection. Of course, up to date the number of cases of reconstruction by the bone grafts and by later plastics is limited. Many of these cases will be available for study and help later; but, without question, the longevity of the infection in the tissues is very striking.

SEROUS MENINGITIS FOLLOWING TRAUMATISM

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The fact that a serous meningitis, without any other complicating injury to the brain, following an injury to the head, could cause death, unexpectedly came to my attention in the year 1903.

A man fell forty feet from a coal-dock, and was picked up unconscious with a compound fracture of the right wrist. He remained unconscious only a few minutes. He was removed to a hospital, the fracture was operated on under an anesthetic, and for five days the man was apparently normal. On the sixth day he began to have headache, and this was followed by a progressive right hemiplegia, which was complete on the ninth day, when I first saw him in consultation. Believing that he had probably fractured his skull on the left side, and that a hemorrhage was taking place from the posterior branch of the middle meningeal artery, I advised an operation to remove the blood-clot. This was declined.

The following day the man became totally unconscious, and when he was in a state of coma, permission was given to operate. I trephined the skull over the middle fossa, and found no clot. Upon opening the dura the cortex of the brain presented an ecchymotic appearance. No cerebrospinal fluid appeared. I passed a grooved director between the dura and brain,

and a few drops of cerebrospinal fluid escaped. In a few minutes this increased to a small stream. At the end of fifteen minutes the patient began to show signs of life. The breathing improved. The operation was performed without an anesthetic. A drain was inserted beneath the brain, and the wound closed. The man made an uneventful recovery, and is still living.

A review of the literature of the surgery of the brain will give but little information on traumatic serous meningitis. The pathology deals almost entirely with cysts, the result of hemorrhage. It is recognized that fracture of the skull is not a necessary factor, as the elasticity of the cranium will permit of trauma to the contents of the skull. There is no doubt that cases similar to the one reported have been seen from time to time, and they may be reported in the literature, but, if so, they have escaped my attention.

For years this case has been in my mind. In the examination of head injuries with marked symptoms of cerebral compression, we usually think of hemorrhage. For a long time it has been my custom to think also of a simple serous effusion, especially when no focal symptoms are present. Within an hour following a serious contusion of the membranes of the brain, fatal compression of the brain can occur from a serous meningitis without hemorrhage. In fact, a valuable aid of prognosis of recovery is the finding, at the time of operation, of a free amount of cerebrospinal fluid.

In looking at a moving picture of a decompression operation last summer, in which a young surgeon of considerable ability and enthusiasm was busily chipping away the skull, after a sufficient opening had been made to show a freely pulsating brain and a large amount of cerebrospinal fluid, I thought that, were he

familiar with the favorable prognosis the initial opening of the skull showed, he might have spared the patient some useful bone.

In reviewing the clinical history of cases of serous meningitis, I am impressed by the fact that, as a rule, there was no primary unconsciousness: a history of being momentarily stunned is about the extent of it. The symptom they all complained of was a frontal headache of severe character. These two facts stand out prominently. The stage in which the case is first seen by the surgeon will show a group of symptoms that are characteristic of cerebral compression. Seldom have we found a choked disc. In every case, however, there has been noticed a tortuosity of the retinal veins.

If the operation is made within forty-eight hours of the accident, in nearly every case there will be found a free amount of fluid, providing of course that the injury received did not cause hemorrhage. I am prepared to say that many cases of serous meningitis following blows on the head are not recognized, because we have been thinking of hemorrhage only as a causative factor, and have not as yet learned to think in terms of serous meningitis. We have yet to learn that a simple contusion of the dura, uncomplicated by hemorrhage, can do the same thing. The unyielding, unbroken calvarium furnishes the counter-pressure for a hydraulic pressure, beneath which the delicate brain structure is compressed. The man who falls backward from a load of hay, and does not fracture his spine; the man struck on the forehead with a fragment of a pulley from a revolving shaft; the man who slips backward on an icy pavement, and strikes his head sufficiently hard, but not hard enough to cause hemorrhage; the automobile accidents; the trolley accidents; the baseball accidents; the elevator accidents;

the falls from ladders—these are the more familiar cases that have furnished material for this paper.

It would indeed be misleading to leave the inference that serous meningitis unaccompanied by hemorrhage is found only in comparatively mild injuries to the skull. Such is not the case. Fracture of the skull may occur without hemorrhage of the brain and without serous meningitis. The important fact to be kept in mind is, that, even with hemorrhage, the accompanying edema of the brain unrelieved by decompressive measures may cause a fatal issue. The turning up of the dural flap in Cushing's decompression is the most important factor of the technic, other than the opening of the dura itself.

The following case, which is somewhat dramatic because of its legal aspect, illustrates what may follow a trivial, insignificant injury to the head. More than a year has passed since the injury was received; and since June of this year the man has been perfectly well and continuously employed.

Case.—In September, 1915, a young man of twenty with an unusually good family history, while working in a munition factory, was passing a press which was operated by a lever, not unlike a pump-handle. As he passed under this lever it fell, striking him on the crown of the head. He ducked his head with the remark: "Gee, but that hurt," and then continued with his work. At supper time that night he told his sister of the accident, saying that he had been nearly killed. The sister then forgot the incident for a period of thirteen weeks. The man continued at his work for six weeks, and nothing unusual occurred during this period. He then began to complain of headache, and said his eyes troubled him. He was sent to an oculist, who made an appointment for him which he failed to keep. He began to show mental impairment, and went from bad to worse until at the end of thirteen weeks from the date of the injury he was absolutely demented. An alienist of more than average ability examined him, and, failing to get a history of an injury to the head, made a diagnosis of dementia precox. Two other

physicians appointed by the court examined him, and recommended his commitment to the insane hospital. These papers were duly filed, but, owing to the fact that it was a busy Saturday, the judge did not sign the papers. The following day at breakfast the sister for the first time recalled the story of the accident, and told it to her father. I was asked whether there could be any possible connection between the trifling accident and the present condition of dementia. The injury itself left no outward mark at the time it occurred. The scalp was not lacerated nor visibly contused, and there was no headache.

Having in mind the first case reported, it seemed altogether probable that the trivial accident had caused a serous meningitis, and that the mental impairment was the result of interference with the circulation of the brain.

On this theory I made a subtemporal decompression, and evacuated four ounces of cerebrospinal fluid of ordinary appearance. I introduced a drain beneath the brain, and closed the wound. During the succeeding days following the operation, there was a gradual return to consciousness, and at the end of ten days the recovery was practically complete.

At my suggestion the patient wrote a postcard to my friend, the alienist, telling him he was making a nice recovery, and hoped that he would call and see him before he left. The alienist, who was present at the operation at my invitation, called me up the following day, and asked how the man was getting along. In answer to the question as to whether he had received a postcard from him, he said, "Yes, but someone else wrote it for him." "No," said I, "he wrote it himself."

The case is reported thus fully because there are in it elements of importance. It was unfortunate that the oculist, the man consulted, did not have time to examine him immediately. He surely would have seen tortuous veins in the fundus, and would have prevented, by an early decompression, the subsequent insanity.

The case is noteworthy, also, in showing that a blow which left no visible evidence and no immediate disability, could so contuse the membranes of the brain as to produce an extensive serous effusion. Until we

know what the factors are which control the secretion of the cerebrospinal fluid and the pressure it exerts in the closed dural sac, we shall do well to recognize that it may cause serious and fatal pressure. All cases will not react alike. There are some cases, however, which show a predisposition to meningeal irritation, and these must be differentiated and early relieved by decompressive measures.

DISCUSSION

Dr. A. E. Halstead (Chicago): My conception of a serous meningitis is entirely different from that of Dr. Lemon. I have had no experience in the class of cases he has detailed. A serous meningitis, as I understand it, is a meningitis that is present from toxemia or from a mild infection in which there is no pus or no gross manifestations of infection in the meninges.

I have operated on several of these cases, one case a couple of years ago, where a boy had mastoiditis, and was operated on over the mastoid. Later he developed symptoms of cerebellar abscess. I operated, and found a circumscribed collection of serous fluid that did not yield any bacteria on culture.

I have also seen cases of diffuse meningitis where the fluid was serous or retained the characteristics of normal cerebrospinal fluid. These cases occurred in the terminal stage of an infection. I remember a few years ago there was considerable literature on what is called meningitis without meningitis—that is, a meningitis in which there were no evidences of pus, but in which there was an increase in the cerebrospinal fluid, and there seemed to be an increase in quantity, with cerebral symptoms, compression symptoms, but where there was no pus found even at autopsy.

I think the weak point in the doctor's paper is, that he has no autopsy to sustain his diagnosis of the appearance of a traumatic serous meningitis. I have seen cases of traumatic, circumscribed, serous meningitis, so-called meningeal cysts. I have operated on several of these cases, and still believe that there is a possibility that some focal infection somewhere else may account for the cysts in part; that the trauma alone is not the whole cause.

The symptoms that the doctor detailed in the first case,

of course, can be explained on the ground of cerebral edema. We all have seen edemas of the brain come on suddenly after an accident, and after trauma, particularly after the trauma of operative interference on the brain. I have had one case of a young man on whom I operated at the Illinois Charitable Eye and Ear Infirmary for brain tumor. In the course of exploration of the brain the man suddenly stopped breathing. His respirations ceased entirely, he became livid, and only after evacuating a large quantity of fluid from the ventricles did he regain his respiratory movements. That has happened several times in operating on the brain where there has been such pronounced edema as to cause almost a fatal termination, and in some cases it does cause a fatal termination.

I am not familiar with the pathology of the disease that has been described by Dr. Lemon. The term *serous meningitis* should be applied only to those cases where a bacteriologic examination has revealed no infection, and where operation or autopsy has sustained the diagnosis of meningitis.

Dr. John L. Yates (Milwaukee): Whatever may be the conception as to the method of formation of cerebrospinal fluid, all must agree that cases showing intracranial hypertension in the absence of a foreign body are explicable upon the basis of a disproportion between the absorption and the secretion of the fluid. Dr. Halstead has indicated one of the causes of this disproportion, chemical irritation as a result of bacterial intoxication. Dr. Lemon, on the other hand, illustrated another type of irritation, the mechanical result of trauma. Serous meningitis may occur with or without focal lesion which may give symptoms. In a serous meningitis without focal lesions pressure may be exerted diffusely or more especially in either compartment. The occurrence of this type of intracranial hypertension must be recognized, as its treatment by decompression, suboccipital or subtemporal, will often determine immediate and remote recovery.

Dr. F. A. Dunsmoor (Minneapolis): It so happens that I was fortunate to be the student of Frank Hamilton in 1873, and one of his remarks made to me is exactly in line with that given by the essayist. He impressed upon me this point: Whenever you see a man who has a slight injury of his head, and he is bewildered or even unconscious for a

moment, and gets up and walks off, make up your mind that there is grave possibility of tragic symptoms a week later.

Shortly after this I was going by a railroad crossing, and saw the driver of a wagon topple off his load, and he gave the same clinical picture. I was the first young doctor present, and I said to a man who stood by, "The railroad company is going to have a damage suit right here." In a little while the man recovered himself, got on his wagon, and drove off. My remark was sufficient to bring me into the court-room afterward to bear out my impression, and why I had made this remark. I said: "There was the good authority of Frank Hamilton for it."

If I glean the right idea from the doctor's paper it is this: Whether you call it meningitis or not, there has been injury within the cranium which does not present external evidence, and it has produced an increase in the amount of serum present within the cavity, and, unless taken care of by a surgeon or by nature, disaster is apt to follow. It is immaterial whether later germs, with their concomitants or without any pressure whatever, are to have a bearing upon the case. The point is, that a man should be astute enough, if he has any sort of history, to go ahead and relieve the condition by surgical operation.

Dr. M. M. Ghent (St. Paul): Dr. Halstead just stated we had had no post-mortem reports to sustain the diagnosis of traumatic meningitis. Many years ago on the Mesaba Iron Range I saw a Finlander that had been struck back of the left ear by an infuriated drunken Austrian. The Finlander was struck by the largest stone or boulder that I had ever seen thrown. It was not more than five minutes after the patient was struck till I saw him. He was in a dazed condition, but in half an hour he was able to talk. There was an abrasion about half an inch long back of the left ear, otherwise there was nothing to find. Soon after the accident the patient vomited, but the next morning he said he felt well except for a severe headache. After twenty-four hours he began to grow worse, suffering from headache, vomiting, and fever. On the third day he was growing worse, and soon became unconscious, running a typical febrile course, just as one would expect in a meningitis. The condition of the patient grew worse till he died, one week after the

accident. Before his death we thought we were dealing with either a cerebral hemorrhage or an infection coming from the small abrasion behind the ear. At the post-mortem the abrasion behind the ear had healed by primary intention, eliminating external infection. Within the brain there was no evidence of hemorrhage, nor was the base of the skull fractured.

The opposite side of the brain tissue was normal, but the brain tissue on the injured side was like putty. The membranes were adherent to the brain substance, but there was no exudate. From the essayist's paper I am sure this was a case of traumatic meningitis, and possibly his operation would have saved the patient's life.

Dr. Lemon (closing): I read this paper, at this time, because nearly everybody that deals with these cases has been thinking along the lines of hemorrhage or the possibility of the presence of tumor. Tumor and hemorrhage are the two things that are uppermost in the minds of surgeons who are doing this work.

For a great many years—twenty years to be more exact—I have been engaged in emergency lines in the practice of surgery. I have seen many hundreds of these cases, and therefore I have gradually had this thought impressed upon me, so that with the lapse of years I have come to the conclusion that there is something to this matter that I have brought to your attention today.

There is no difference in the way of thinking between a serous effusion following a blow on the dura and a serous effusion following a sprain of the knee-joint. You do not have bacteria, but trauma—mechanical irritation, as Dr. Yates has suggested. Why did that first case show focal symptoms? It seems to me that Dr. Yates explained it here. The man fell and struck the left side of the head. He had a serous effusion into the meningeal sac, and he had a contusion of the brain on the left side. Now, if you bear in mind there are two factors producing cerebral compression, then the subject may appear clearer to you. First, there is the serous effusion itself mechanically increasing the pressure within the cranium; and, secondly, there is edema resulting from the interference with the venous return circulation. The longer the patient remains unoperated on, the greater will the edema become and the greater will be the added pressure from the serous effusion within the dural sac.

An injury to the left side of the brain causing contusion of the brain, will produce in the course of a few days a right hemiplegia, because of the presence of edema early at the point most contused. Dr. Ghent's patient showed a putty-like condition on the left side because he was hit there with a stone, and, if the serous meningitis had been treated immediately or within the first twenty-four hours, there is no question in my mind the man would have recovered.

REMOVAL OF PORTION OF STERNUM FOR LIGATION OF THE INNOMINATE ARTERY, WITH REPORTS OF TWO CASES

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ST. LOUIS, MISSOURI

The operation of ligation of the innominate is so far, apparently, not a popular one. Thompson,[1] of London, was able to collect 26 cases operated on since 1880, and of these only 12 recovered. In 12 the innominate alone was tied, with 5 recoveries, and in 12 the innominate and common carotid with 7 recoveries; while in 2 the innominate, carotid, and vertebral were tied, with no recovery. In the face of such data there seems to be reason for the unpopularity of the operation.

To enter into a discussion of the best method of dealing with aneurysm of the various parts of the right subclavian or carotid, is not the present intention of the writer. I suppose that no one will gainsay the statement that a case may present itself in which it seems best to ligate the innominate artery, or, at any rate, to temporarily occlude it, totally or partially. One can conceive of an aneurysm in the root of the neck so close in toward the inner end of the clavicle as to convey the idea that the first part of the subclavian or the beginning of the carotid is involved, and at the same time the swelling may so fill the side and base of the neck as to render distal ligation most difficult of attainment and most uncertain of result.

One may decide to extirpate an aneurysm in either of the above-named sites, in which case temporary arrest of the stream through the innominate would perhaps facilitate the matter. Again, in the obliteration operation of Matas,[2] we have the counsel of the master himself, who advises temporary occlusion until one is certain that the collateral circulation is good. And that there have been and will continue to be cases of bleeding where ligation of the innominate is the only or the last resort of the surgeon, needs, I am sure, no argument.

Ordinarily, when one wishes to tie a vessel, he approaches it by the most direct route,—"cuts down on it," as the expression has it,—and with the least trauma and the least dissection possible applies his ligature, and closes the wound. Even third-year students now learn that trauma favors infection, and infection is almost the only cause of secondary hemorrhage. Why then in ligature of the innominate,—that operation where secondary hemorrhage has been the cause of death, both before and since the days of Lister, in over 75 per cent of the mortality list,—do we not act as we do when tying other arteries?

The incision of Mott[3] has been that most often used. When the aneurysm is small, or when the neck is long and thin and the division of the innominate high, the operation is difficult. I have never had occasion to attempt it on the living, but I have done it more than once on the cadaver, and when I imagine what it must have been in the presence of an aneurysm, with the engorged veins, the struggling patient, and the lack of direct light, I tremble with fear, and am speechless with awe and admiration at the courage and skill of Valentine Mott. If difficult under favorable conditions, what might it be in the presence of a short innominate, a short fat neck, or a large aneurysm en-

croaching against the sternal end of the clavicle and upper end of sternum?

Graefe, in 1822,[4] made one incision only, downward along the inner border of the sternomastoid. Cooper, of San Francisco,[5] in 1859, resected the inner two inches of the clavicle, having found an aneurysm on the carotid and another on the subclavian. Moynihan[6] turned up the inner end of the clavicle and the adjacent corner of the sternum, The operation of Graefe, who failed to divide the muscles (sternomastoid, sternothyroid, and sternohyoid), rendered the work of the operator and assistant more difficult than any other, but made far less dead space—so the author believed. The removal of the inner end of the clavicle certainly gives more room, and ordinarily is not difficult. If, however, the aneurysm be large, it must not be forgotten that the bone itself may form part of the wall of the sac, just as the vertebræ, ribs, or sternum often do in aneurysm of the aorta. I know of one such case in our own city, in which, while the clavicle was being removed in the attempt to excise the aneurysm, the sac wall was opened, and the patient bled to death. Again, after having removed the clavicle, one may find a low division, and then be obliged to remove the upper part of the sternum. The cavity left after having removed a small portion is harder to obliterate than that left when a large portion is removed.

Spencer,[7] in 1889, experimenting on monkeys, used a vertical median incision with a transverse at the lower end, through the skin only. Twyman[8] used the method in 1890. Percy Sargent,[9] in 1911, used the median incision, and removed the right half of the manubrium with forceps, and Herzen,[10] in 1910, used the incision of Spencer, and removed the inner third of the clavicle, and, in addition, removed the upper end of the sternum with Luer forceps.

Several have used the median incision, and have split the manubrium,—the so-called incision of Bardenheuer. A great deal of traction is required to separate the edges of the split manubrium. To maintain the space at three-fourths of an inch for the necessary time would probably overtax the strength of even the best assistants. Sheen[11] advises the procedure, and suggests an automatic screw-retractor. Such an instrument might serve the purpose if it were at hand.

What objection can be raised against the removal of the upper part of the sternum? I mean its total removal, say, from just above the third cartilage upward. The sternum acts as a fulcrum for the clavicle when the shoulder is moved; yet the whole clavicle is often removed, and I have seen such a case, and know that before six months have elapsed the patient can use the corresponding limb as well as ever. Some human beings are born without clavicles, and others with very rudimentary ones. This being so, it seemed to me that the loss of the sternal support of the clavicle is not an objection to the operation. And in Case 1 herewith reported the patient after three months was able to use the left upper limb as well as ever (the right still is paralyzed), and the sternal ends of the clavicles are held firmly to the first ribs by their original rhomboid ligaments and to each other by scar tissue. Another objection is, that there is increased danger of injury to the lungs or the pleura. This seems to me not to be true; in fact, I quite believe that the danger of injuring the pleura or other important structures, is far greater when the other methods are used. Futhermore, if one should injure an important structure, how much easier it is to repair the damage when one has free access and good light. Again, it may be said that it weakens the chest and leaves important viscera exposed to trauma. This seems to be

the best and only real objection, and this can be overcome by leaving the anterior periosteum as I did in my second case. However, in Case 1 the hollow now existing is not more than the width of my index-finger. The question of shock may arise as an objection in the minds of some. I can only say that there was no very serious shock in either of the cases here reported. The additional time required may be another objection; however, by the older method, I see that it has sometimes taken from two hours to two hours and a half. By this method with good assistance I feel the additional time, if additional time be required, is not an objection of any weight.

The chief reasons for its removal as low as the upper border of the third cartilage are, first, that it gives an abundance of room, and allows one to work without danger of injuring important structures, and that the partial occlusion or temporary occlusion may be done, and the permanent done at a later date without encountering greater difficulty or risk at the second operation; and (2) that it is an advantage to cut straight to the artery without any blunt dissection, since these procedures favor slow healing and suppuration. The important structures, except the left innominate vein, do not come into one's field at all, and this can be readily pulled down when one has room. Finally, in closing, one can very easily obliterate all dead space in the chest by sewing the incision in the soft tissue, in front of the artery, thus still further lessening the chances for infection.

The skin wound does not close well without under cutting; but, if this be done out for say two and a half or three inches from the cartilage ends, the flaps fall easily into the place formerly occupied by the bone, and slight pressure prevents the accumulation of fluid under them.

The following two case-reports will illustrate the method advocated. The illustrations herewith shown refer to the method used in Case 1. In Case 2 the method varied a little. The incision was a median one, and the anterior periosteum was reflected with the overlying tissues. There was hardly any bleeding. There was room, but not quite so much as in the first case. It would have been better to have removed more of the cartilages, but they were cut as close as possible to the edge of the sternum. The internal mammary arteries were not even seen.

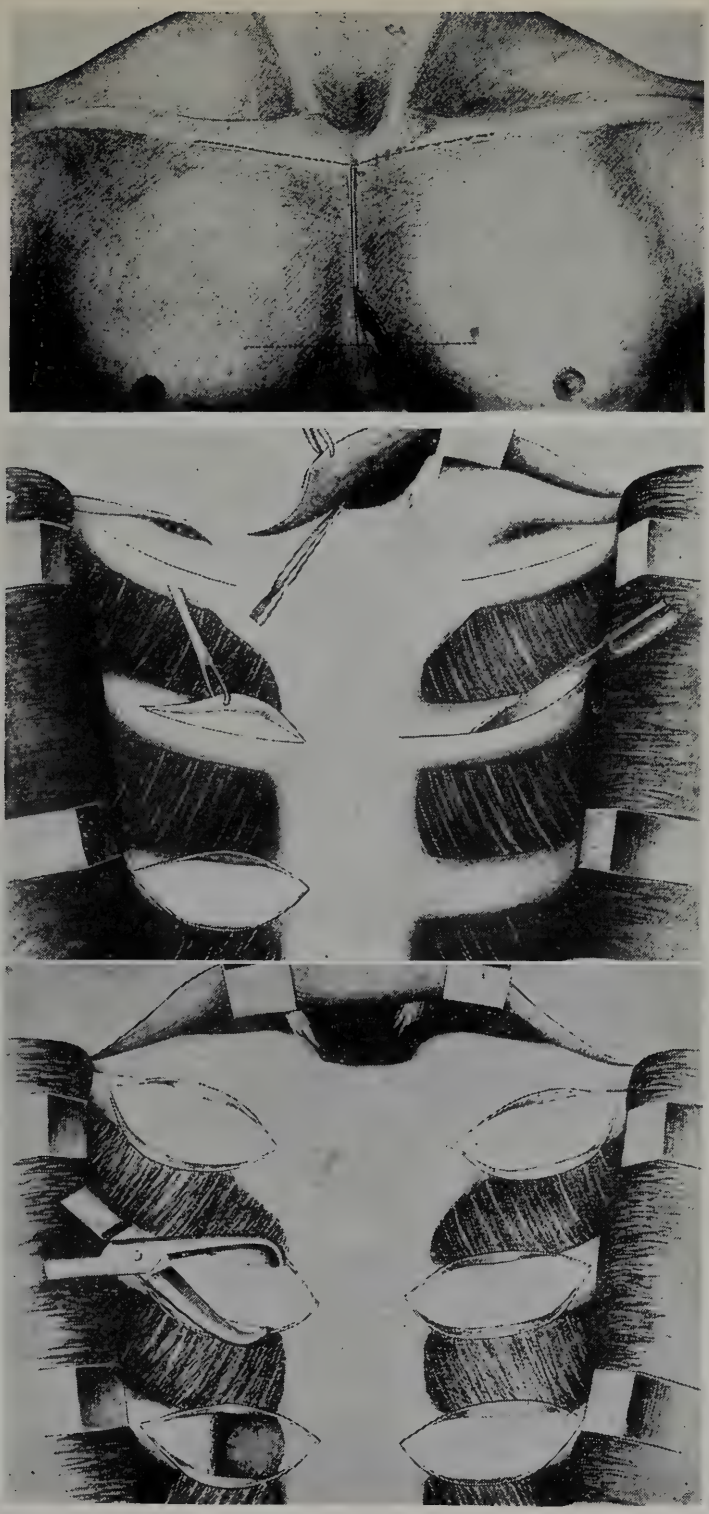
Should I ever be called upon to operate in a similar case, I should use the same method as used in Case 2, but would remove the inner one-half or three-fourths inch of each cartilage. I believe the conservation of the anterior periosteum of the sternum will perhaps lead to the re-formation of a bony support between the ribs, and so do away with what I regard as the most powerful argument against the removal of the sternum in ligation of the innominate, although in my opinion the argument is not of any great moment.

CASES

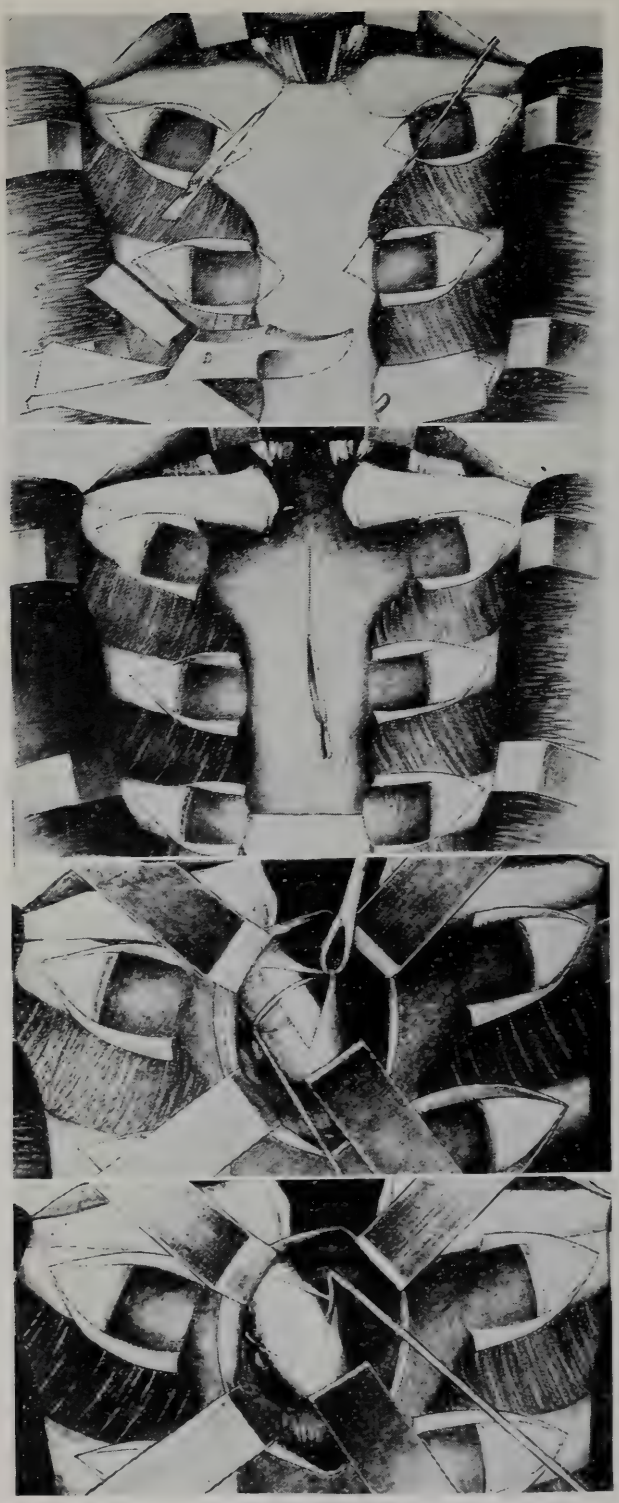
Case 1.—A negro, C. B., laborer, aged 28, admitted May 9, 1916. The patient was suffering from aneurysm of the right subclavian artery, and it was decided temporarily to occlude the innominate and later to ligate the same.

First operation, May 18, 1916. Ether by the intratracheal method. An incision was made in the median line from the level of the upper margins of the clavicles downward four inches; an incision transverse one and a half inches outward on each side from upper end of the first; and a third similar to the second and parallel with it at the lower end of the median incision as shown in Fig. 1.

The two flaps thus outlined, composed of all tissues down to the bone, were reflected outward so as to lay bare the sternoclavicular joints, and the sternum and inner ends of the cartilages of the ribs as low as the third. (Fig. 2.) The perichondrium over the chondrosternal joints was incised, and the cartilages of the upper three ribs divided sub-



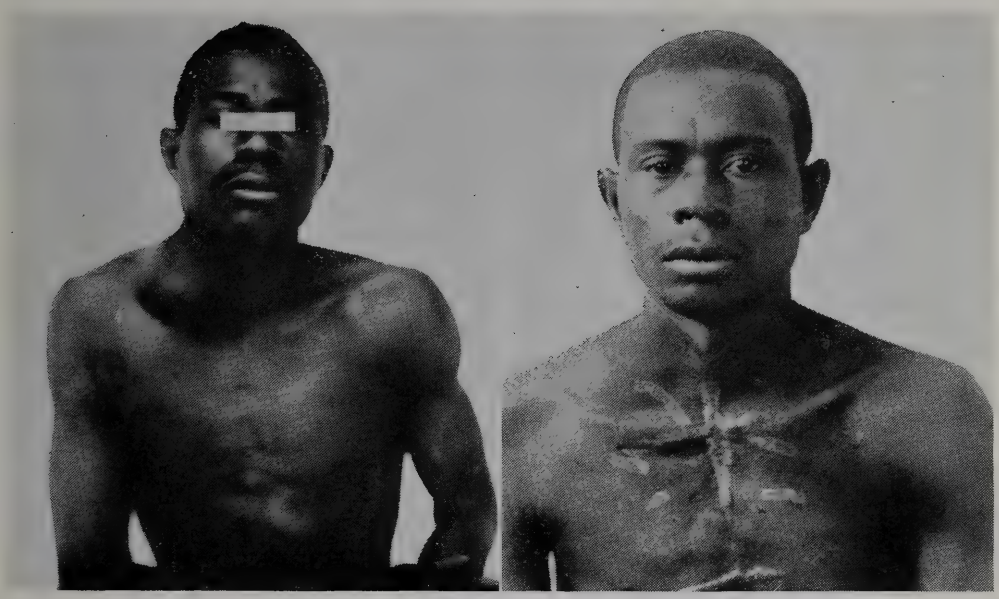
Figs. 1-3.



Figs. 4-7.

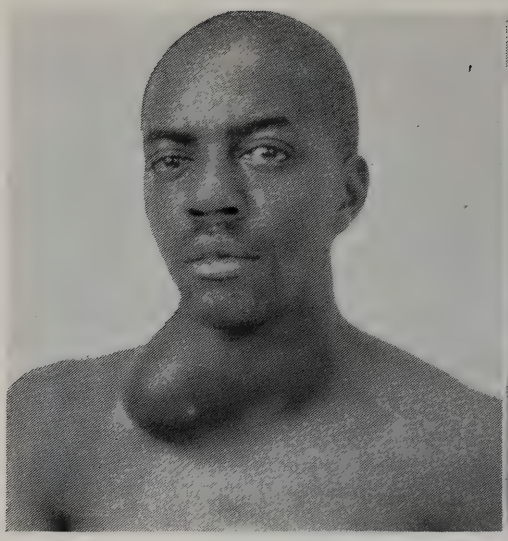
Case 1.

Before operation. After operation.

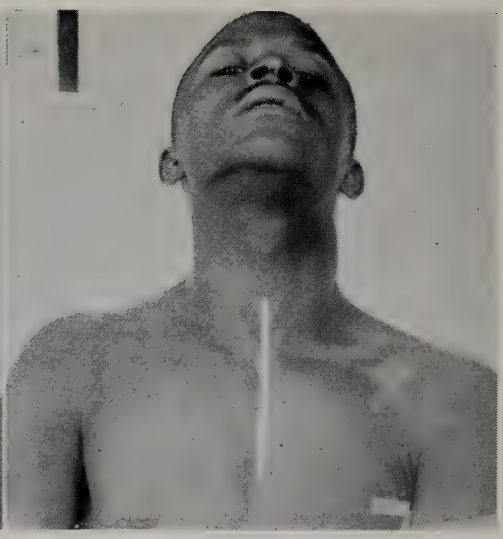


Case 1.

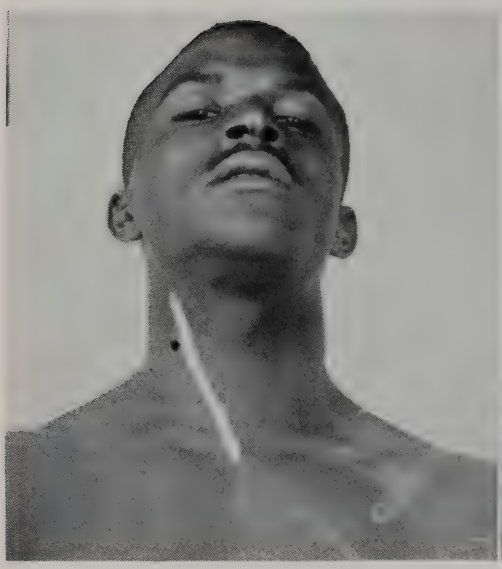
Before operation. After operation.



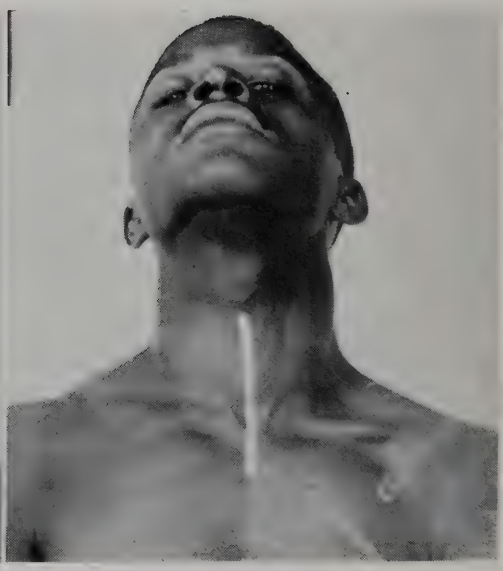
Case 2.



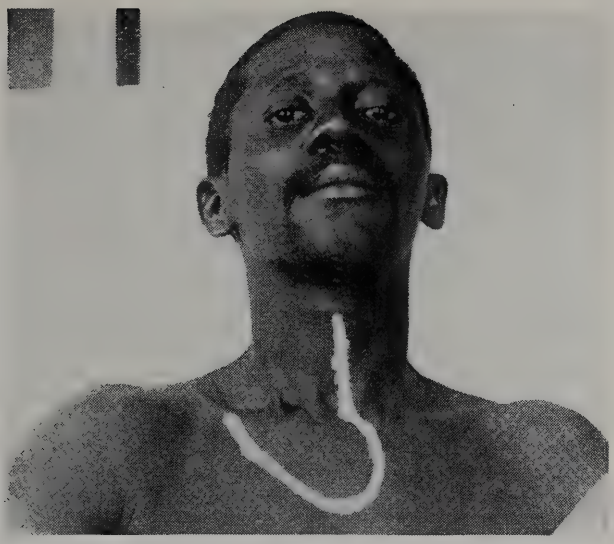
Author's incision used in Case 2.



Graefe's incision.

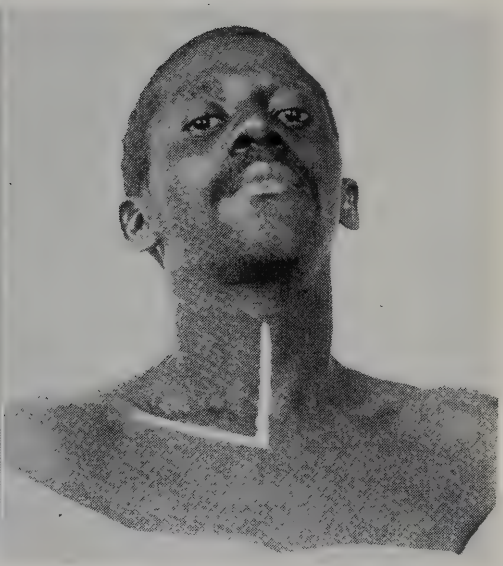


Sargent's incision.



Moynihan's incision.

Mott's incision.



Spencer's incision.

perichondrially with ronguer forceps. (Fig. 3.) The sternal heads of the sternomastoid muscle, the anterior sternoclavicular ligaments, and the interarticular fibrocartilages were divided close to the clavicle. The muscles and fasciæ in the intercostal spaces and the perichondrium of the divided cartilages were separated from the sides of the sternum. A flat, thin, blunt-ended spatula was passed across behind the sternum at the level of the third cartilage, and the sternum was divided with a thin-jawed rib-shears as shown in Fig. 4.

The lower end of the upper fragment of the sternum was now raised up, and the retrosternal tissues divided from below upward with a sharp knife, keeping close to the bone. As the upper end was neared, the origins of the sternothyroid and sternohyoid muscles were divided, and the posterior sternoclavicular ligaments severed, and the loosened piece of sternum removed. A median incision was now made through the retrosternal fascia and fat from above downward, and the left innominate vein was exposed as in Fig. 5. The vein was drawn downward and the artery easily located, its sheath opened, and the vessel separated from the sheath for a space of about three-fourths of an inch. (Figs. 6 and 7.) An aluminum band, C-shaped, about 3 cm. by 1 cm. by 2 mm., was passed around the vessel and rolled together so as to reduce the diameter of the artery to about half its former size. The incisions in the sheath of the vessel and the retrosternal fascia and fat were closed with plain No. 1 catgut. The flaps of the skin and superficial fascia had retracted, but by undercutting, good apposition was easily secured, and the wound was closed with silkworm gut and clips. A gauze pad was adjusted so as to bring the skin flaps into apposition with the retrosternal tissues, and this was held in place with adhesive and a bandage, including neck and chest.

There was a great deal of bleeding from the soft tissues on the right side,—a general oozing, very hard to control; but there was little on the left. The patient's pulse rose to 160, and intravenous saline was given. The time required was one and three-quarter hours. The internal mammary arteries and veins, although seen at the upper part of the wound, were not molested. The pleuræ, although, according to the experience gained in the dissecting room, overlapping at this level, did not come into contact with each other, but a space of at least one-half inch intervened.

The patient recovered, and three weeks later, under local anesthesia, the incision was reopened, and the innominate was tied just distal to the band, and also the right common carotid was tied just below its point of bifurcation.

The patient is still living and his aneurysm seems cured.

Case 2.—W. G., a mulatto, bartender, aged 37.

Diagnosis, aneurysm of the right subclavian or of the right common carotid low down.

Operation for the purpose of partially obliterating the current through the sac was undertaken October 23, 1916. Local anesthesia, novocain 0.5 per cent with adrenalin, gtt. 4 to the ounce. Median incision four inches long, downward from a point about one inch above the upper end of the sternum. The periosteum was loosened laterally as far as the edges of the sternum, from the level of the third cartilage up. The cartilages of the upper three ribs were divided subperichondrially close to the sternum, a narrow-jawed ronguer being used. The sternal head of the sternomastoid was loosened from the bone, the anterior and superior sternoclavicular ligaments were divided, and the interarticular fibrocartilage divided close to its clavicular attachments. The intercostal muscles and fascia in the first two spaces, the perichondrium of the first three ribs, and the anterior periosteum of the sternum were divided along the edge of the sternum. A blunt, thin, flat retractor was passed across behind the sternum at the level of the third cartilage, and the bone was divided with a narrow long-jawed ronguer. The lower end of the upper fragment was now drawn forward, and with a sharp knife the retrosternal tissues were separated from the posterior surface of the same from below upward. The origins of the sternothyroid and sternohyoid were cut, the posterior sternoclavicular ligaments were severed, and the fragments of the sternum removed.

The remainder of the operation was proceeded with as in Case 1; but in trying to pass the band behind the artery the vessel was broken posteriorly, and the patient bled to death.

No effort was made to close the wound afterward, so that one does not know whether the tissues would fall in to touch the retrosternal tissues as they did in Case 1. A most striking difference between the two cases was the amount of blood lost while reflecting the flaps and exposing the artery, hardly any bleeding taking place in Case 2. This was due to the use of adrenalin in the novocain solution and to the fact

that the flaps included the periosteum of the anterior face of the sternum. Also in Case 2 the flaps were not dissected up from the ribs as far out as in Case 1; therefore, none of the anterior perforating arteries or branches of these or of the anterior intercostals were cut.

The access was hardly as good as in Case 1; however, it is not to this that I attribute my lack of success in Case 2, but to the fact that the artery was very friable (luetic arteritis), and was so firmly fixed in its sheath that I probably weakened the vessel wall in my attempt to separate them. Furthermore, the band was not as blunt and smooth as it ought to have been, and it is possible the space cleared posteriorly was not as wide as it should have been, and, in addition, I did not lift the artery forward while passing the band or interpose a director as I should have done.

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DISCUSSION

Dr. Roland Hill (St. Louis): It was my good fortune to witness both of these operations, and also the post-mortem upon the last case.

If I were to be so precisely critical as my friend, Dr. Hertzler, I would suggest a change in the title of the paper, because it was not a ligation of the innominate, it was simply a constriction and narrowing of the innominate by means of the band of Halsted. This, I think, is a very important point.

As to the operations that come before our minds in a case of this sort we have but three plans: First, primary ligation or constriction, as was done here. The use of silver wire has been recommended, and the use of terminal ligations. The use of silver wire with the electric current I have seen produce very favorable results in one case. The terminal ligations seem to have the weight of authority behind them because of the lower mortality in this class of cases. Pri-

mary ligation, I believe, would be much more dangerous than the operation Dr. Coughlin did.

Some time ago I had occasion to ligate the left subclavian for an aneurysm of the upper part of the axillary. In that case the patient went off the table in excellent condition, but in about three or four hours had a collapse. The temperature went to 106°; the pulse became almost imperceptible; the patient broke out in perspiration, and we thought he would die. What caused this condition I do not know. Heat-stroke sometimes follows this. He rallied in a few hours, and the next day he was all right. If that will occur in the ligation of a vessel like the subclavian, how much more likely is it to occur in a case like the innominate, if that vessel were tied off suddenly?

The use of the bands of Halsted, as advised, seems to be absolutely ideal. In the operation as performed by Dr. Coughlin in the first case he had a great deal more bleeding than in the second. I do not like his first incision, where he made a cross incision and got a good deal of bleeding along the edges of the sternum. In his second operation, which was done under local anesthesia, there was practically no loss of blood. The operation was ideal. The artery was very clearly exposed, and the inflammatory condition around it could be seen, and it was with the greatest difficulty and care that he succeeded in passing a director underneath. He made one effort to put the little band underneath, and the vessel wall seemed soft and pliable, the end caught, and he brought it back and tried again to carry it underneath. The vessel was so pliable that the band penetrated, and the end was one of the most dramatic I have ever seen.

I think that these cases have been two of the most interesting I have seen in some years, and Dr. Coughlin is certainly to be congratulated on the success he has attained.

Dr. Arnold Schwyzer (St. Paul): When Dr. Halsted first brought out his bands I happened to have a case of aneurysm of the innominate artery, and I wrote him and asked him where I could get the instrument. He most kindly sent me his own because it was not on the market yet. I was going to get a solid tube with rather sharp edges. I found I could roll it beautifully and use it easily on an artery that is more accessible, at least for my hands, than the innominate. It seemed to me that, if it was placed on

these large arteries (like the aorta or the innominate) with a very violent systolic impulse, it might be risky. I excused myself before Dr. Halsted, mentioning that I was afraid it might cut through. Just a few months before, Guinard, in the *Revue de Chirurgie,* reviewed all of these aneurysms of the innominate artery, and he came to the conclusion that the best results were obtained by distal ligation, according to statistics. So, naturally, that review came handy for me, and we ligated the common carotid and subclavian.

There is one important technical point to be remembered, and that is, you first ligate the common carotid because otherwise the whirl in the aneurysmal sack may force a clot into the brain. Of course, ligation is not very easy when the tumor is so large as you have seen in the cases here reported. However, in my case the tumor was not so large, but was apparently more in the chest, and the operation of ligation could be done. The man was a syphilitic; he had been flat on his back for six months. He had been under the care of different men and had had plenty of antiluetic treatment. Ten days after the operation he was up and around. He has had no trouble since.

In distal ligation, it seems, according to the statistics of Guinard, that, if we first ligate the common carotid, we have no great mortality. A little over two months ago I had an interesting case of aneurysm of the abdominal aorta. The man had severe pains, and gradually had developed a large mass. We operated on him, I had the band in my hand, but I did not dare use it, so we used something that is used nowadays for many purposes, and that is a strip of fascia lata. That strip was three centimeters wide, and long enough to go twice around the aorta. We made a double loop. The tissues were infiltrated, and the aneurysm was already glued to the surrounding tissues and the peritoneum. We hardly dared touch this tumor. We had to tie as it seemed just underneath the superior mesenteric. The middle colic or the inferior mesenteric were stretched over the upper pole of the tumor. We went in first, after freeing the aorta, with an aneurysm needle threaded with catgut, and with this catgut we drew the fascia flap through, and once more went through the same maneuvers; and after tying it once we fixed it with linen sutures. The severe pain from which the patient was suffering disappeared at once. The next day he was very happy.

I hope I may be forgiven for reporting this case on account of substituting a fascia flap for the aluminum band. I feel if we had used an aluminum band, instead of a fascia flap, where the lumen in the aorta was less than that of a lead-pencil, as we found later at autopsy, the artery would have been cut through with the band. Ten days later we tightened the constriction again because the posterior tibial artery began again to pulsate too much, and some pain was caused. After tightening it again, everything was all right for a short while, but presently the man became worse, and two weeks after the second operation he died from hemorrhage. There was no infection.

Dr. John P. Lord (Omaha): Some years ago, having a case of carotid aneurysm to deal with, I devised a band according to Halsted's idea to use in the particular case. It was made from an ordinary aluminum pie-tin from which I made a variety of sizes to suit the emergencies of the case, and I found that with the use of one of these bands which I had made that it was only necessary to expose the circumference of the vessel; it was not found necessary to pass anything about it. I was able, therefore, by holding the band in a forceps, to pass it about the vessel, and to pinch it to the desired extent. This band, with its base pointing outward, was readily found subsequently, and with another pinch of the forceps it was closed. I think, as illustrated in the cases of the essayist, the passing of a carrier and ligature around an artery proved to be rather serious. It simplifies the technic by applying a clip or band of this kind, and it is unnecessary to pass behind the artery. The difficulty in passing the ligature proved to be the undoing of an otherwise daring and skillful undertaking.

Dr. W. D. Haines (Cincinnati, O.): The point that interested me most in the doctor's work was the technic. I presented before this Association a method for removing a tumor of the thymus, which was a combination of the Bardenhauer incision and that of Milton, of England, who divides the entire sternum, also the technic as modified by Farquar in our country. By dividing the upper portion of the sternum longitudinally and putting in retractors, you can separate it to the extent of doing a great deal of work. But the doctor did an ideal thing in resecting the first portion of the sternum. Mediastinal tumor cases are desperate surgical risks. We have everything to gain in such cases and prac-

tically very little to lose. I think subperiosteal resection of the entire upper portion of the sternum is the ideal operation. It gives plenty of time, and probably the only thing that will confront us in the way of hemorrhage is the internal mammary, which is a very bad subject with which to deal in case you injure the vessel.

The two-stage operation, I believe, is a very important factor. The little puddling which takes place after operation does not trouble one very much. It can be readily overcome by turning the patient on his stomach, in which position the fluids will drain from the mediastinal wound as rapidly as they form.

Dr. Coughlin (closing): It was not my object to arouse discussion as to the treatment of subclavian aneurysm, but as to the method of approach in this particular type of operation. I will only say, if I tried it again, I would use a median incision, as I did in the second case, and resect the portion of the sternum subperiosteally. I did not bother with the posterior periosteum at all, but took it with the bone.

As to bleeding, in my second method to which attention was called by Dr. Hill: There is not any.

If you stick to the median line, and reflect the whole covering, periosteum and overlying tissues, as one flap, and get back to the edges of the cartilage, the internal mammary does not come into view at all.

CARDIOLYSIS: A FURTHER REPORT, WITH NOTES UPON AN ADDITIONAL CASE

John E. Summers, M.D., F.A.C.S.

OMAHA, NEBRASKA

Four years ago at the Cincinnati meeting of this Association, I presented a paper entitled "Boning of the Thoracic Precordial Wall in Certain Affections of the Heart: Report of a Case." The case was one of mediastinopericarditis treated by cardiolysis after the suggestion of Brauer. In introducing the subject I remarked that this procedure, cardiolysis or pericardiac thoracolysis, has found no favor in America. Why this is so is incomprehensible to me, because the operation is based upon good mechanical principles, is not difficult of execution, nor has it a high mortality. The danger of the procedure is so inconsiderable in proportion to the good to be expected that every physician should familiarize himself with the diagnosis of the conditions calling for the operation, and every surgeon should, in addition to this, learn the technic. Let me briefly recapitulate the history of cardiolysis and the indications and contra-indications for the procedure.

According to Brauer, whenever, in pericarditis, the heart becomes adherent to the pericardium, and the pericardium to the mediastinum, pleura, and chest-wall, a great burden is added to the function of the organ. In systole it tugs against the bony chest, every beat being a strain upon its musculature; but the more evident the sign of tugging, the better the condition of

the heart muscle, and the more surely will relief come to it if the overlying bony wall is removed, changing it "into a movable elastic wall formed solely by musculocutaneous flaps." Internal adhesions of the pericardium to the heart may not, of themselves, be of great moment, and usually are difficult to diagnose; but, if, with their occurrence, the pericardium itself becomes adherent to neighboring organs, as the mediastinum, diaphragm, sternochondrocostal wall, the function of the heart will be interfered with in degree comparable with the elasticity of these adhesions. The chest-wall itself, except in the intercostal spaces, yields scarcely any at all; consequently, the heart muscle gradually becomes weaker and weaker as a result of the strain. It is in this latter condition, before the heart muscle itself is worn out, as evidenced by damming-back symptoms, that Brauer proposes the operation of cardiolysis, or, as I, in my paper, called it, "boning of the precordial chest-wall."

Brauer postulated that for the success of the operation the following conditions must be present: diastolic shock, systolic retraction at the apex, and the ability of the heart muscle to compensate. If from myofibrosis, myocardial degeneration, or valvular disease, the heart is unable to compensate, the operation will be futile. If threatened heart-insufficiency is not too marked, if the liver is not too large and ascites too great, much relief may be expected. But, above all, the patient must be one whose heart still responds to medication and relief from all strain. This in itself is proof that there is still tone in the heart muscle, and that it will be markedly benefited by untethering its fastenings to the chondrocostal chest-wall. Hearts weaker than this will scarcely be benefited by operation, and will tend to bring any operative procedure into disrepute. "Anatomically, and to a lesser extent clinically, pericarditis

may be divided into the following types: diaphragmatic, pleural, chondrocostal, and mediastinopericarditis. The cases may be said almost never to be of the pure type. The existence of the chrondrocostal type is necessary if we are to expect anything from operative interference. The heart is hitched fore and aft to the chest-wall and to the vertebral column by involvement of pleura, pericardium, and posterior mediastinum. It is at this double pull that our therapy is directed. Another indication for removal of the precordial chest-wall is brought forward by Morrison. In a patient with cor bovinum from mitral and aortic disease, who suffered from frequent and severe anginoid pains that resisted treatment, he removed four and one-half inches and five and one-half inches of the fifth and sixth ribs, respectively. The result was subjectively and objectively gratifying, so that the patient was able to earn his living, which he had previously been unable to do. He was reported much improved one and one-half years after the operation.

As indicated above, the principal diagnostic signs of adhesive pericarditis, are systolic retraction at the apex, the diastolic shock, epigastric diaphragmatic tugging, Broadbent's sign, and cardiac and pulmonary immobility. For a more complete exposition of this subject I will refer you to my former paper, and likewise to a paper by Dr. Arthur D. Dunn and myself on mediastinopericarditis, published in the *American Journal of the Medical Sciences,* January, 1913.

My chief object today is to report the subsequent history of the patient operated on in March, 1912, and also briefly to refer to a second case and report the result. It may be recalled that my first patient, a young man twenty-nine years of age, clinically presented all the symptoms which I have said were essential to the diagnosis of mediastinopericarditis. In addition, he

could not lie down without several pillows under him. He spent his nights largely in a chair, and was unable to move without choking and coughing. He could eat but little. The abdomen was distended; the bowels would not move without a cathartic; the urine was scanty and high-colored, sharply acid, with a specific gravity 1,030, albumin present, and sugar absent; the scrotum, thighs, legs, and feet were moderately edematous. Hyaline and granular casts and red-blood cells were quite numerous. The patient was placed in the Clarkson Hospital, where, in the course of three weeks, compensation was restored; the heart action became regular, the murmur entirely disappeared, and the heart sounds became clear. The patient's temperature was normal throughout the entire time. After a further delay of ten days the cardinal essential for the success of the operation (namely, compensation), having been brought about by rest and medical treatment, cardiolysis was performed. At the time of my report, nine months after operation, the man was free from all the distressing symptoms for the relief of which the operation was done, and continued so, with several slight remissions (attacks of de-compensation), able to perform his work as a florist, until this fall. After the work of the summer a severe attack of decompensation made it necessary for him to stop work, and he again entered the hospital under the care of his physician, Dr. Dunn. Notwithstanding the rest and proper medical treatment, after a stay of several months in the hospital the man died four years and ten months after operation. The post-mortem disclosed the following:

The usual fixation of the pericardium, in a broad mediastinal pericarditis. No adhesions between the pericardium and the epicardium; the latter over the left ventricle much thickened, indicating possible early adhesions to the pericardium. The heart itself was very much enlarged; the walls thick-

ened; all the valves normal and competent; no change in the coronary arteries or in the aorta.

Microscopical examination:

1. The heart: The greater part of myocardium, normal, except for possible slight increase of interstitial connective tissue; occasional hemorrhage, which may have occurred in the course of removal of specimen. Here and there in the myocardium are areas of what are apparently degenerated portions of heart muscle; in these the muscle-cells stain more faintly than normal; they are much swollen, the cytoplasm is granular, the nuclei are irregular and fragmented. More extreme stages of the same process show, in addition, loss of cellular outlines. Such areas show a very slight peripheral ingrowth of connective tissue and capillaries. As a rule, these changes involve distinct, fairly large areas of myocardium, but here and there can be seen single muscle fibers that show the same change, and are surrounded by muscle apparently normal; also the areas referred to above show projections into them of unchanged myocardial tissue. In general, these changes are suggestive of unequal fixation, but it is difficult to explain all these features on this basis. In addition, there is fragmentation of certain areas.

2. The spleen: marked passive congestion.

3. The liver: same as spleen.

4. The kidney: marked engorgement of vessels of glomeruli and cortex in general. Very marked parenchymatous degeneration of proximal convoluted tubules, much less pronounced in the distal tubules. Marked edema of medulla.

After a careful study of the record in this case, there is nothing shown as the cause of the myocarditis with its extreme, almost necrotic degeneration of the heart muscle. Repeated Wassermanns had been negative, but there is a loop-hole through which, possibly, we may find a reason why cardiolysis was not a more permanently successful procedure. This is, that the man suffered from periodical attacks of inflammation of the tonsils, and the record clearly indicates that during and immediately following these attacks the heart suffered in consequence. This, at the time, was thought to be purely the constitutional expression of the tonsil-

lar inflammation, and its specific influence was not considered. Had the tonsils been removed, it is suggestive, at least, in the light of the knowledge of today, that early tonsillectomy would have been a rational practice.

Within the past year I have had the opportunity of performing cardiolysis in a second case, although one of a somewhat different type and of which I will briefly give the history, the temporary, rather brilliant result, the cause of the breakdown, and the post-mortem findings.

Patient is a young woman, aged 23, a resident of Denver. About four years ago she began to suffer from shortness of breath; then her feet began to swell; rheumatism and the usual diseases of childhood—measles, scarlet-fever, etc. Her father died of heart disease; the cause of the death of her mother unknown; two brothers living—one has rheumatism and one has pleurisy.

Physical examination: Patient is thin and anemic; slightly cyanotic; pericardial friction-sound over the precordia; systolic murmur at apex; apex in anterior axillary line; veins in neck widely congested and cord-like; but negative venous pulse. Patient is orthopneic; right border of heart one-half inch to right of sternum. Liver is enlarged to umbilicus; ascites present; and edema of feet and legs. Lungs give râles over the bases; no fluid. Urine, slightly albuminous, due to pus from a mild cystitis. Leukocytes, 9,600. Weight, 121⅛ pounds. Under the usual heart treatment the edema disappeared, and the pericardial rub more or less subsided; then a distinct precordial retraction was manifest; Broadbent's sign was present. Compensation was restored, and the liver returned to its normal size.

She was operated on on December 14, 1915. Large sections of the third, fourth, and fifth ribs were removed from the sternum out. In doing this two accidental incisions were made into the pleural cavity, but no collapse of the lung took place. When the ribs were cut away the whole heart fell from the chest-wall, and found the place made for it. The operation was followed by an attack of suffocative pulmonary edema, which was very life-threatening, but the edema gradually disappeared. Following this, however, a

rather general edema took place which did not diminish under digitalis, notwithstanding the heart seemed to be in pretty good shape. It was necessary repeatedly to aspirate the pleural and abdominal cavities. The patient remained in the hospital one hundred and thirty-three days, and thereafter returned to be tapped every two or three weeks, until August, the intervals gradually growing greater and greater. During this period she was sufficiently physically well to purchase an automobile, which she daily drove. Finally, she felt so well that she wanted to go to her ranch in Colorado, and she personally drove her car (a large one) from Omaha to Denver. Later she made a trip across the Rockies, at one time venturing to an elevation of 12,000 feet, and seemingly suffering no inconvenience. She returned to her ranch, where she indulged in very hard work. She was a very self-willed young woman, and took advice pretty much as suited her temperament. On October 31, she returned to the hospital under the care of her physicians, Drs. Crummer and Anderson, her heart having, a few days before, broken down under the strain of too arduous exertion. Decompensation was present in a rather marked degree, and attempts at restoration of compensation were hindered because of nausea and vomiting due to passive congestion of the abdominal viscera. The abdomen was aspirated several times, and the patient was apparently improving, when, on the 15th of November, after a slight exertion, she suddenly died.

A rather interesting coincidence, this girl and my man patient both died in the Clarkson Hospital on the same day. The post-mortem revealed a heart so massive that it practically filled the entire left thorax. Dense bands of adhesion extended from the mediastinum to the right lung at the anterior edge; the entire precordium was attached to the ribs and under the sternum. It extended backwards into the axilla. The left lung was forced backwards in the pleural cavity until it occupied a space scarcely more than if completely collapsed, and was held by adhesions to the pleural diaphragm and pericardium. The parietal and visceral layers of the pericardium were adherent over the entire heart. The liver was enormously enlarged. The findings show that it would have been impossible in this instance, to free the heart by such a meager operation as had been done. It would have demanded radical anterior costal excision to the axillary line, and likewise of a part of the sternum. No *microscopical* examination was made.

As I stated formerly, and in the beginning of this paper, it is incomprehensible to me why Brauer's operation has received so little consideration in America. So far as I am informed, my cases are the only ones that have been done here. Altogether, in France, Germany, and England, thirty-eight patients have been operated on. Perhaps this dearth of operations for the relief of a progressively bad pathological condition may be best explained in that physicians in general do not accurately differentiate the lesions of the heart and of its sac, and, when cases of mediastinopericarditis *are* recognized, the hope of cure by surgical means has long-time passed. The fault is not with the operation.

A word again as to technic: Practically nothing is found in English literature about this procedure. Only one of our text-books (Johnson's) gives it place. He says: "The operation was devised for the purpose of removing the ribs which imprison the heart and interfere with the cardiac systole. The rigid, bony wall of the thorax is thus replaced by a soft elastic covering which is easily moved by the heart, and part of the cardiac power which previously had been wasted in overcoming the resistance of the thoracic wall, is conserved. The removal of the bony framework of the chest also permits the heart to drop back into the thorax, thus relaxing the lateral or posterior adhesions which may be present." In order that this may be accomplished it is essential that the ribs be removed in such a way that there can be no re-formation of bone, —namely, they must be removed with all of their periosteal covering. Although it is not easy to remove the posterior periosteal covering of the ribs, still it can be done, and it is no material disadvantage if, in the doing, the pleura *is* opened once or several times. The lung does *not* collapse, and the injury is easily repaired; besides, intratracheal insufflation anesthesia

can be employed if desired, and this would eliminate any possibility of lung collapse. Johnson makes the statement that the periosteum, which has been detached by the incision along the middle of the rib, is ablated after the removal of the ribs, in so far as this can be done without endangering the pleura. It is, in my opinion, a mistake to limit the removal of the periosteum to that which has been detached by the incisions along the middle of the ribs, this limitation being done to prevent the supposed dangerous consequences of pleural injury. Our knowledge of modern surgery of the chest does away with this bugaboo.

DISCUSSION

Dr. W. R. Cubbins (Chicago): I think Dr. Summers is to be congratulated on his courage in undertaking operative interference in these cases. There is no question that the relief should be, and will be, marked where we have enough courage to remove the chest-wall as it should be done.

As far as the paucity of literature is concerned, I could not find anything published in America in recent years concerning this operation. I feel, as Dr. Summers does, that this thing should come from our medical men, and the only way medical men will ever recommend this is for us to show them a few good results, as Dr. Summers has done, and in that way stimulate them to give us an opportunity of showing what relief can be obtained by releasing this heart muscle from the constant pull.

Dr. R. C. Coffey (Portland, Oregon): I know that not all of these cases have been reported. Dr. William J. Mayo and I, while attending a clinic in New York, given by one of the most prominent teachers in that city, saw performed one of these operations which Dr. Summers has described. Intratracheal anesthesia was given, and just about the time the chest-wall was completely removed, we suddenly saw a tidal wave come over the face of the patient; the patient closed his eyes, and never breathed again. That case has not been reported. Death was due to a catheter that was introduced into the lung, and the apparatus which measured the pressure had been broken, and death was due to rupture of the lung.

Dr. Summers is certainly to be congratulated on his splendid primary success with his cases, but, I think, a larger experience in less experienced hands would be very discouraging.

Dr. G. M. Gray (Kansas City, Kan.): I want to add to Dr. Summer's paper a case on which I operated for Dr. Bohan. This case was thoroughly worked up by Dr. Bohan, and he requested me to make a resection of the ribs, which I did, resecting, as I remember, the fourth, fifth, and sixth ribs.

This was done about one year ago under local anesthesia, with novocain and adrenalin. The patient was markedly improved, and has been exhibited before one or two medical societies by Dr. Bohan since that time.

The patient was a young man, thirty or thirty-two years of age. Dr. Summers can obtain the full particulars in regard to this case from Dr. Bohan.

Dr. Summers (closing): I have nothing in particular to add, except to say that I reported this procedure, and a case on which I did the operation four years ago, thinking it would be the logical thing to report the *result,* as well as to report an additional case, thus trying to excite some interest in the subject—an important one.

I want to apologize to Dr. Binnie because he tells me that he has discussed this subject in his book. I thought I knew his book from A to Z; it seems I am mistaken.

CONSERVATIVE FOOT SURGERY, WITH REPORT OF A CASE

John Prentiss Lord, M.D., F.A.C.S.

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For many years I have contended that practically all of the ancient classical tarsal amputations (with all due respect to their distinguished authors) were unworthy of the space that they continued to occupy in stereotyped text-books. The dictum, as set forth by Agnew, Guerin, and Mayer,[1] that the bones of the foot should be considered one, and divided by the saw at such point as to conserve the greatest amount of foot and function, is correct, and has been followed by me for nearly a quarter of a century. For years men have been using old time-worn methods, intent on getting flaps to cover, and have been sacrificing the skeletal structures with everlasting loss to the patient, just because a doctor is so busy in the study of the anatomy and in the pursuit of a technical amputation, following the masters.

In my early years in surgery I made the claim that skin defect was not the determining factor in foot amputations. I skin-grafted or subsequently covered with flaps from the other leg feet deficient in skin covering, and thus saved practically all of the solid structures of feet, not actually devitalized by crushing or mutilating injuries. Bone-defect should no longer be a cause for amputations except, perhaps, in exceptional cases. Lack of blood supply is, in the final

[1]Matas: Parks' Surgery.

analysis, practically the only indication for amputation if we properly apply present-day knowledge. This is even more true today, and should be emphasized, since the added experience from the European war. These remarks are a repetition of my early teaching. I believe that time—and our present advancement—strengthens my position on the subject of emergency amputations in general. The number of primary amputations, therefore, should be greatly lessened.

I have been free to state, in my later years, that the majority of operators do not know their limitations. This is too conspicuously true in amputations.

While rabbit-hunting in November, 1914, a lad of sixteen was accidentally shot in the right foot by his companion, the muzzle of whose gun was about eighteen inches distant. The charge of No. 4 shot carried away nearly the entire thickness of the tendo Achillis, the posterior tibial group of tendons, and the artery, vein, and nerve, together with the internal malleolus, inner half of the astragalus, a portion of the scaphoid, and the distal portion of the tibialis anticus tendon, and all of the skin, fat, fascia, and ligaments in the path of the charge, leaving an excavated trough through the structures mentioned. There was little hemorrhage.

The wound was antiseptically dressed by the attending physician, Dr. Kalar, of Bloomfield, Nebraska, who called me in consultation. At the forty-eight hour period, when first seen, the wound was clean, though blackened. Any loose shreds of tissue left by the clean-cut effect of the charge, had been removed at the first dressing. To avoid amputation was the first thought of all concerned. The difficulties in saving the foot, however, were fully appreciated by the attending physician and the consulting surgeon. To successfully combat the results of an impending infection in this

open wound, with all of its exposed cartilage, bone, ligaments, nerves, and tendons, was our problem. The first step was to minimize the extent and the effects of sloughing and suppuration. We, therefore, cut away every shred of tissue that we thought would not remain vitalized. The ligaments were very closely trimmed, and the tendons were picked up and pulled out until the uninjured portions appeared, when they were cut off and allowed to retract within their sheaths, the collapse and healing of which would stop otherwise inevitable infection and sloughing, the occurrence of which would mark the beginning of probable disaster. This forestalling of infection in the soft parts, however, did not remove the danger from the inevitable devitalization of the cartilaginous surfaces exposed in the wound.

The patient was brought to the Clarkson Hospital, Omaha, on the fourth day. The implantation of an attached graft of skin, fat, and periosteum-covered bone from the tibia of the other leg, was considered as a means of filling this unusually excavated wound. This plan was rejected on account of the greater probability of deep infection in the inevitably devitalized cartilages in a closed and covered wound, and so inviting involvement of the remaining tarsal joints. The plan adopted seemed to offer less possibility of deep infection. This decision was the outgrowth of the writer's very considerable experience with astragalectomy for the correction and stabilization of various classes of extreme club-feet. The outer remaining half of the astragalus was excised December 10, 1914, and the cartilaginous surfaces were removed from the tibia, fibula, scaphoid, cuboid, and os calcis. The external malleolus was shortened, and the os calcis gouged on its outer superior surface to allow the malleolus to rest one-half inch forward of its normal po-

sition, and thereby produce a more shapely and probably more useful foot, as recommended by Whitman, who originated this most valuable operation for talipes calcaneus. When the tibia and fibula were brought in contact with the os calcis, the original wound on the inner border of the foot was almost closed. The parts were stabilized by a temporary twelve-penny wire nail driven through the os calcis into the tibia. The foot was further fixed by a plaster dressing. Healing was uneventful. The nail and the plaster were removed one month later, and a lighter cast was worn for four months.

At this stage much of the hyperemia and swelling had subsided, and the final stage of the operative plans was carried out. The course of the former wound was laid open, and extended up the leg and forward behind the scaphoid. The Achilles was spliced by tenoplasty fortified by sutures of silk, and the posterior tibial tendon was restored in like manner. The flexors were not restored; the tibialis anticus was. The two and one-half inches defect in the posterior tibial nerve was restored by splitting one-half the nerve for about three inches from the proximal end, which was turned downward and united to the freshened end of the distal portion. A new bed in fatty tissue was made to avoid the subsequent involvement of the nerve in cicatricial tissue, and the other repaired structures were similarly protected. Aside from some marginal necrosis of former scar tissue, there was ultimate sound healing. For more than a year there has been good use of the foot. Sensation has returned, except in a small area on the heel. A trophic ulcer on the under surface of the heel at the site of the incision for the nail, has been rather persistent, but is now healed, after the use of a pad of felt, and so trimmed as to remove point-pressure in parts attenuated from deficient innervation.

The leg is five-eighths of an inch short. The deficiency is partly corrected by a generous felt pad under the heel and by extra lifts on the heel of the shoe. The young man's walk is characterized by a very slight limp, due to a stiff ankle, but there is no pain.

I am quite confident that from present-day text-book knowledge and in the hands of the vast majority of operators, such as treat cases like the preceding, this foot would have been amputated.

DISCUSSION

Dr. H. E. Pearse (Kansas City): The first point that strikes us in discussing Dr. Lord's paper is the question of basing amputation for a foot-injury upon the blood supply rather than upon the destruction of the bony structure, or upon the possibility of making a suitable covering for the injured or uninjured bone ends by a flap. We owe a good deal to Dr. Lord for his continuous agitation of this subject. He has presented it, to my knowledge, twice before this Association.

It is sometimes a little difficult in actual practice, particularly in the emergency and accident wards of large hospitals, to estimate the point where the blood supply becomes sufficient and insufficient, where the injury has been a crushing one and not associated with much, if any, hemorrhage.

I have found a little procedure or device which I learned many years ago from another practitioner for ascertaining this point. I do not recall his name. It consists of pouring over the part ether or gasoline, or some other agent that does not leave a stain or a mark, and then with a sterile brush scrubbing it dry by means of good, active irritation, and it is beautiful to see the red blush that follows this irritation, and see how abruptly it ends at the point where the circulation is deficient; and if you do not amputate, you can predict absolutely where the line of demarcation is going to be in the soft parts, due to the dry scraping of the parts after the injury.

In the second place, I wish to commend in Dr. Lord's paper particularly his very sound mechanical principles in moving the center of gravity in the foot forward in those injuries in which it is necessary to do away with the ankle-joint—and doing away with the ankle-joint means doing away

with the astragalus, the mobility of the ankle-joint depending upon it. In these cases he paved the way for his perfect bony union by the entire removal of the cartilaginous surfaces, and, secondly, having lost the keystone of the arch, he moved the weight-bearing portion forward to the anterior pillar of the arch.

In the third place, the doctor teaches us a valuable lesson by the painstaking and masterly way in which he dissects out the nerve supply of the foot later and balances the foot, to be rewarded with returning sensation. That is even more valuable and more remarkable to me than the mere obvious benefit to be derived by his long tenoplasties, which were successful. From a careful perusal of Dr. Lord's paper, we can learn lessons of value, particularly in the cases of persons who receive crushing injuries.

THE TRUTH ABOUT THE VARIOUS THERAPIES IN CANCER

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The facts here presented concerning the value of the various treatments of cancer were learned during an experience with 2,379 cases of "real" cancer treated by means of incisive surgery, radium, *x*-rays, coagulation surgery (cauterization, dessication, diathermy, or caustic methods), mixed toxins, various serums, vaccines, colloidal metals, etc.

We are all familiar with the orthodox statement that surgery is the best treatment for cancer. We are all familiar with the enthusiastic reports of the radium, *x*-ray, toxin, vaccine, and other therapists who treat cancer. We are all familiar with the increasing mortality of cancer, even in the acknowledged surgical centers. He who can learn the truth concerning the claims of these various therapies, and so state the virtues of each treatment that it will be self-evident that the just claims of each have been recognized and fitted into a clear statement which can be understood and accepted by the medical profession in general, will have performed a signal service of benefit.

Surgery to the average person means cutting with an aseptic scalpel, and such a procedure is called an operation. An operation is the most employed, most recommended method in the treatment of cancer, and yet operation alone, as it is applied to the people in

general by upwards of three thousand "recognized" surgeons and many more "unrecognized" ones, is not the best treatment in certain classes of cancer, notably basal-cell epitheliomas and inoperable cases of cancer. The reports of cures by the radium, *x*-ray, toxin, and other therapists who treat cancers do not die out, but keep coming from men, all of whom are earnest, and many of whom are honest, observers. There must be some truth in these methods; and, in order to ascertain the value of these various methods, the Cornell Cancer Commission was organized, and they conducted work at the Memorial Hospital, New York City. They have been working for the last three years, and up to November, 1916, when I completed my work with them, we had observed 2,379 cases, most of them inoperable cancers. Of these cases, 944 were treated by *x*-rays; 943, with radium; 303, with surgery; 11, by coagulation, using the Stroebel method; 15, by the Percy method; 128, by mixed toxins; and 25 by various experimental forms of therapy, such as colloidal copper, immunized sera, etc.

We think we have made some important observations which may help those who are doing this work. Our best results were obtained by the use of radium, *x*-ray and coagulation. There is no doubt there is some truth about radium and *x*-ray cures. The question is, how much truth there is, and that, I think, can be determined. I have studied the microscopical sections from my cases that were favorably influenced, and I believe I can show you why we can logically expect good results in some cases, while in others we can logically expect bad results. To understand the applied therapeutics of radio-active agents we must first understand their physiological actions.

The main action of radium and *x*-ray on the human body is dependent upon the effects of radio-activity on

two things: (1) the nucleus of cells, (2) the endothelial lining of capillaries.

The action on the nucleus in stopping nuclear division is particularly marked where there is rapid cell-division, as in embryonal tissue showing karyokinetic figures. This stops cell-division, and the action on the endothelial lining of the capillaries causes the endothelial cells to swell up and occlude the vessels, ultimately resulting in endarteritis obliterans, which starves the cells. This inhibition and starvation leads to degeneration of the cells. If the microscopical examination shows there is more cell substance than nucleus in the cancer to be treated, there is a less favorable result from radio-active treatment.

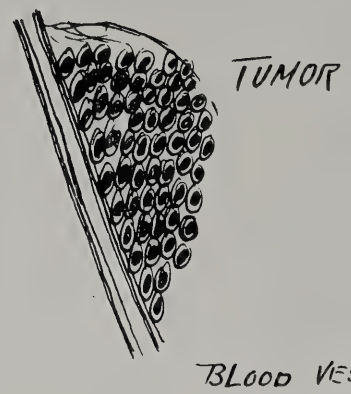
We are all familiar with the facts of the destructive action of radio-activity on the testicular tubules and the germinative layers of the ovary, on ova in general and other tissues where cell division is rapid and the tissues of an embryonal type. Careful observers have always been impressed with the marked improvement in all enlargements of the lymphatic glands from any cause (leukemias, pseudoleukemias, Hodgkin's disease, enlarged thymus, and splenomegalias) when submitted to radio-activity. All of us know how blue with nuclei are microscopical sections of lymphatic tissues. We also know from animal experimentation and clinical observations that malignant tumors do disappear under radio-active treatment. These patients do get better. We also know that some few of these cases develop immunity to cancer, and stay well. Many of them become symptomatically well for a greater or less period of time. We also know that the great majority of these patients subsequently relapse, and die of the disease, which has been palliated by the radio-active measures. We also know that in a case in which the tumor has been made to disappear by radio-active treatment,

if we remove the tissue from the site in which the tumor was formerly situated, and make careful serial sections, we shall find viable cancer cells among the blood-vessels that were too large for the endarteritis to block up, and that, should these cancer cells grow up again a second time, they do not succumb to radio-active measures as readily as they did at first.

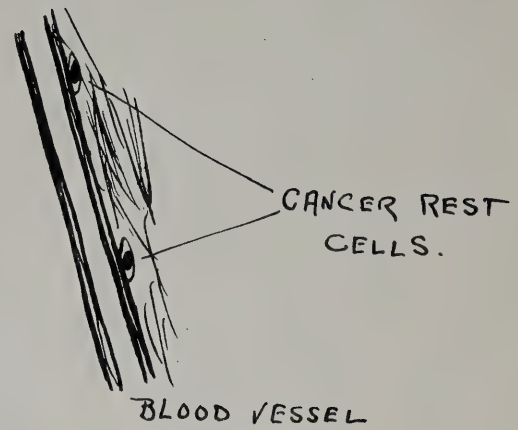
Our experience has led us to talk little about *cures,* and much about *ameliorations,* because most of our cases who improve or become symptomatically well under treatment sooner or later relapsed, for reasons which I will show in the accompanying diagrams. (Fig. 1.)

In all of this I see a scientific reason which accounts for the initial enthusiasm of the therapist and the patient, and the ultimate scepticism of the incisive surgeon, as to the success of the various therapies. This explanation ought to lead to a better mutual understanding and appreciation among the cancer therapists, and the incisive surgeons, as well as a better working hypothesis in the treatment of cancer. If surgery is the best treatment for cancer, what one means as surgery should be defined as including radiologic, as well as coagulative and incisive, surgery.

The real cure of cancer is not known, and the list of things recommended to cure cancer is suspiciously long. At present the best-working hypothesis is surgery, but it needs a little plus at times, in fact, most of the time. Radio-activity and coagulation are offered as good pluses,—adjuvant treatments to surgery. When the real cure of cancer is found, we will do without all these things, for destructive surgery at its best is a recognition of our inability to control certain cells. [Numerous slides were shown at this point by Dr. Holding.]



Before Treatment.



After treatment.

Diagrams of cancer cells before and after treatment with radioactive methods, illustrating a tumor rich in nuclei and, therefore, more susceptible to radioactive agents. After treatment a few cancer cells persist along the blood-vessel wall.

In answer to the question, "Is radium any good for cancer"? "Is the *x*-ray any good for cancer"? "Is coagulation any good for cancer"? I would say, in radium, *x*-ray, and coagulation methods we have three things which should be used in connection with surgery for cancer. They are not cures, but valuable adjuncts, so valuable, I believe, that our work shows that no treatment of cancer is complete without them. They in themselves are not enough, but they are valuable adjuncts to surgery, and must be so recognized and used by surgeons.

LIGHTNING: SOME OF ITS EFFECTS

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Every action, chemical or physical, within the universe is accompanied by the generation of electricity.

Atmospheric electricity is generated by the friction of the wind and currents of air upon the vapor in the atmosphere, and by the molecular changes in this vapor, whereby they are converted into positive and negative electric ions. (*Scientific American,* No. 106.) The generation is more active when the vapor temperature is raised by the heat of the sun and later cooled by currents of air. (*Scientific American,* No. 625; Henry, *U. S. Bulletin,* No. 30.)

The earth is in a state of permanent electrification. The vapor in the atmosphere in condensing forms clouds, which in passing over other clouds and over the earth become charged by induction with electricity of opposite polarity to that of the earth.

Under ordinary conditions electricity in the atmosphere is neutralized by the insensible interchange with the electricity of the earth. This takes place in the form of usually invisible discharges from the top of every mountain, hill, building, tree, or metallic object. Discharges of this character take place from the human body, and, when in high altitudes or on mountain peaks, it may cause muscular rigidity and discomfort.

The electrical tension of the atmosphere may become very great. When the charges attain sufficient

intensity that insensible neutralization becomes inadequate, the insulating air-space is broken. The charges rush together, and neutralize each other by a series of flashes, accompanied by the generation of light, heat, and sound. Lightning is the term applied to this visible discharge of electricity.

The zone of danger may extend beyond the storm area. (*Sc. Am.,* No. 625.) Any upright or prominent object, being a better conductor of electricity than air, is liable to be struck. The electrical strain is taken up by every object in contact with the ground in proportion to its conduction and insulation.

Guerike, in 1650, was the first to discover the means of producing the electric spark. (Flammarion.) Nothing was known of the nature of lightning or of its relation to electricity until 1708, when Wall drew attention to the similarity of lightning and the sparks obtained by rubbing a piece of amber. Franklin, in 1750, proved that the atmosphere was constantly in a state of electrification and with others demonstrated that lightning and electricity are identical. The degree of atmospheric electricity increases with the distance from the surface of the earth. (Flammarion.)

Lightning tends to obey the laws governing electricity. It is of such incomprehensible strength and the factors incident to its development are so imperfectly understood, that the laws controlling its dissipation have not been fully determined.

A flash of lightning is a rapid succession of (15-40) distinct sparks (1/5000 to 1/500 second duration) of progressively increasing length, projected along the same general path. The succession of sparks gives to lightning its flickering appearance. The entire flash varies from 1/1000 to ½ second duration.

The direction of the flash is a matter of dispute: it may take place to or from the earth.

The discharge usually takes place between the most prominent or proximal points. It follows the line of greatest conductivity or of least resistance. The charge may be so great that the main path is insufficient for its conduction. It may jump out of the main course, or form numerous branches (*Sc. Am.*, vol. 80). The course taken is determined by the intensity of the current and by the conduction or resistance encountered. The path may be altered by the wind or by the hygrometrical state of the atmosphere. (Flammarion.) These conditions account for the sinuous, spiral or irregular appearance of lightning.

Unsuccessful attempts have been made to determine the current-intensity, the frequency, and the amperage of lightning. These have been variously estimated—voltage as high up in the millions (5000 millions). The frequency as medium. (5000 to 300,000, *Emede Sc. Am. Supp.*, No. 697.) The amperage upward of 10,000. (Brockels.)

So long as resistance is not offered lightning is harmless. (*Virchow's Archives,* vol. xx.) Lightning will leap over a non-conducting surface more readily than through air. Insulation afforded by auto tires, etc., and the safety thereby conferred is a fallacy. (*Scientific American,* November 7, 1914.) *Protection does not lie in providing insulation or resistance, but in establishing a path of greater conductivity and of less resistance than the body.* Conducting bodies or objects are more liable to be struck, but are damaged less than resisting bodies. (*U. S. Bull.,* No. 56.)

There is an uncertain periodicity associated with the frequency and the severity of electrical storms. They are more frequent in the temperate zones during the summer months and in rainy seasons. They are five times more frequent east than west of the Rocky

Mountains, and more frequent in high mountains and on open plateaus than along the coast, or in low altitudes, in wet, marshy districts more than in dry districts.

The geologic as well as the topographic character of a region exerts an influence upon the site and the severity of a lightning stroke. (*Sc. Am. Supp.*, No. 24; *U. S. Bull.*, No. 15.) Loam, sand, clay, marl, and chalk predispose in the order named. Rocks are not often struck. They may be split or moved in great masses, or their surface vitrified. Fulgurites may be formed when lightning strikes dry soil rich in silica. Any tree may be struck,—in order of their frequency, poplar, oak, elm, conifer, walnut, ash, and beech. The richer in starches and the poorer in oils the more susceptible are trees. When struck the tree may be split, separated into layers, splintered, or broken off obliquely, or transversely. It may be stripped of limbs or bark. The bark may be grooved vertically or spirally, may be ignited (2 per cent), or may be stunted or stimulated in its growth.

Buildings are susceptible in proportion to their size, height, or nature of their construction and insulation.

Lightning is more frequent (five times) in rural than in urban districts. The more thickly settled and the better built a section is, the less frequent and destructive will be the lightning.

Occupations which keep one in the open, especially in sparsely settled or open districts, increase liability,—cattlemen, woodmen, farmers, etc. Animals are more frequently struck than men. All species, even fish in ponds and streams, have been affected. When animals are struck they rarely survive.

No accurate statistics of lightning casualties are available. Most fatalities and the greatest property damage occur during the months of June and July.

The largest number of deaths occur in the Mid-Atlantic states. The greatest proportionate mortality is noted in the mountain states of Colorado, Montana, and Wyoming. Over sixteen hundred cases of lightning accidents are recorded yearly in the United States. One-third of these result in death. Nine-tenths of the deaths occur in rural sections.

Lightning has a tearing or explosive effect. It has a greater tendency to bend or break than to burn or fuse. The effects are largely mechanical, the result of pressure fluctuations. The disassociation of gases (*Virchow's Archives,* vol. xx) or the generation of steam by the current is claimed to explain many of these mechanical effects. (*Lancet,* 1879-1909.) The charge in passing through the body is not evenly distributed. It may remain superficial, follow channels, such as blood- or lymph-vessels, or be transmitted through bones and nerves.

The body may not be visibly affected, may be left in the same posture as before the stroke, or thrown more or less violently many feet and not injured. (*Lancet,* 1909, vol. I.) Mutilation in varying degrees to complete dismemberment or incineration may result.

The clothing may not be affected in any way. It may be stripped or burned, in part or entirely, shredded to ribbons, either warp or woof may be destroyed. Seams may be ripped, linings or undergarments destroyed leaving the outer garments and the skin intact. (Flammarion.) Metallic objects in or of the clothing are bent, broken, more or less fused, or not affected. The shoes most constantly show the effects of the current. People are usually standing when struck, the current then enters or leaves the body through the feet. The shoes, especially when dry or only partially damp, interpose a substance of increased resistance. One or both may be affected. They may be gently removed,

or violently thrown many feet, be punctured or have a large hole torn in any part, shredded, split, reduced to lint, or disappear entirely. The soles may disappear with or without the heels. Any of the foregoing may occur and the person not injured or only slightly shocked.

The amount of damage to the clothing or to the surface of the body is no index to the extent or the severity of the injuries sustained within the body. Either may be disproportionately great or small.

As lightning travels faster than sensory impulses, or the tracts are blocked, the injuries at the time of their infliction are usually painless.

The symptoms may be divided into (1) external or mechanical, (2) internal or essential, (3) mental or psychical.

External or mechanical signs are most marked at the points of entrance or the exit of the current. The nature of the injuries is determined by the position of the body, the condition of the skin, the character and condition of the clothing, the presence of constricting bands of metallic parts, and the proximity of conductors and contacts.

The skin offers greater resistance than any other tissue. The resistance is five hundred times greater when dry or oily than when wet. This difference accounts for the wide variation in the character and degree of its injuries, which are burns, lacerations, and contusions.

Burns range in degree, from singeing of the lanugo and mildest erythemas to complete incineration. They vary in extent from minute punctate to extensive irregular areas. Burns which at first appear small and superficial may later assume a more extensive and deep character. They may partially heal and later break down, not only in the scar, but in the adjacent

Fig. 1. Internal aspect.

Fig. 2. External aspect.

Fig. 3. Comminuted fractures resulting from direct explosive (lightning) violence.

Fig. 4. Extensive laceration through the entire foot exposing the tarsal bones, illustrating explosive or tearing effect of lightning.

apparently healthy tissue. They take longer to heal than ordinary burns.

Erythema may be the only manifestation of lightning stroke, or may accompany burns, as a circumscribed area or as irregular, narrow or broad, more or less branching bands. The resemblance to trees, ferns, etc., gives rise to the popular fallacy of lightning photographs. It has been asserted that these peculiar configurations are due to vasomotor paralysis, and to disintegration of the blood in the superficial vessels and capillaries. They are not confined to the distribution of these vessels. Rindfleisch (*Virchow's Archives,* vol. xxi) proved they are due to the effect of the current on the tissues, the irregular and branching distribution being caused by the difference in resistance.

Vesication and pigmentation may accompany burns and erythemas as brownish areas, hard dry parchment-like or soft, with vesicles containing more or less altered blood.

Contusions, from the mildest, with slight ecchymosis, to the most severe degree, with extensive hematomas, may occur.

Lacerations may be single or multiple, clean-cut or irregular. They may be superficial, confined to the skin, or deep, involving not only the subcutaneous tissues, but also the muscles, fascias, vessels, nerves, and bones. Either may be extensively involved without the other.

Joints may be dislocated; bones may be fractured. Fractures are direct, caused by the lightning, or indirect, due to muscular contractions, the throwing of the body, or by objects falling on the body. When direct they are usually comminuted or complex, and occur at joints, particularly where several bones enter into the formation of the joints,—for example, ankle and spine. A break in the continuity of the bony tract

conducting the electric charge increases the resistance and admirably illustrates the law: damage is in proportion to the resistance.

Important vessels may be ruptured, causing alarming or fatal hemorrhage or irreparable damage. Any viscus may be lacerated or ruptured with or without damage to the overyling tissues. Eye injuries may result promptly in cataract. The choroid or chorodial vessels may be ruptured; retinal hemorrhage or detachment, paralyses of the muscular apparatus and of accommodation, or atrophy of the optic nerve may occur. (*Medical News,* 1888.) The ear may be torn off, membrana tympani ruptured, or the auditory nerve injured.

The actual destruction of tissue resulting from the purely mechanical effects is of secondary importance, so far as life is concerned, to the interruption or the destruction of the physiology of the vital centers. This pathological physiology explains many of the internal or essential symptoms.

The internal or essential symptoms may be divided into primary and secondary.

Primary symptoms may be very slight,—a mild sensation of giddiness or blunting of intellectual faculties. Loss of consciousness, more or less complete, lasting from a few moments to days, may terminate in death. Return to consciousness may be sudden or by stages. Collapse with pale clammy skin, difficult, slow, and irregular respiration, irregular, feeble pulse, and dilated pupils, may enter a state of suspended animation, during which there is neither respiration nor pulse. This lasts a variable period, usually short,—and, if not promptly treated by artificial respiration deepens into death. Lastly and most awe-inspiring is instantaneous death without macroscopic lesion.

Secondary symptoms are in all probability dependent

upon some tissue-change. Loss of memory may be complete or confined to the accident, temporary or permanent. Aphasias of any kind may result. Growth of the affected part may be permanently stunted.

Motor.—Tonic or clonic contractures, rhythmical or irregular, general or confined to the injured part. There may be paralysis,—mono-, hemi-, para- or quadriplegia with or without involving the sphincters. Difficult mastication, deglutition, or phonation may result. Vertigo, ataxia, or loss of coördination may follow; and also convulsions, true epilepsy, or epileptiform.

Sensory.—Pains, general or confined to the area affected, sharp, severe darting, or paroxysmal in character or a dull ache are sometimes seen; and also hyper-, para- or anesthesia.

Special sense,—deafness, dulling of hearing or buzzing in the ears. Blindness, blurring of vision, double vision, loss of color-sense, lachrymation, photophobia, ptosis, or loss of accommodation, often result.

Resulting mental or physical neuroses may have a pathological basis. Functional traumatic neuroses, mental or intellectual impairment, insomnia, delirium, mania, are conditions seen. Hypersensitiveness to electrical storms, ranging from fear to positive pain, may be produced.

The prognosis should always be guarded. When symptoms have no demonstrable pathological basis they are usually temporary, but may last for months. Death may be instantaneous, a direct effect of the lightning upon the myocardium (fibrillation) or upon the respiratory centre, or both. It may be more or less sudden, due to shock following the stroke or to gross lesion of the vital centres; or it may be slow from delayed shock of the injuries, as a direct result of the injuries or consequent exhaustion.

The diagnosis of death due to lightning depends upon the presence or absence of positive findings at autopsy and upon the conditions and circumstances attending the finding of the body at the site of the accident. The post-mortem changes may be negative. Evidence of violence may be entirely absent. Body temperature may be elevated for a considerable period. Rigidity sets in early, and passes rapidly. Putrefaction may set in early, and progress rapidly.

Brain and nerve tissue, being better conductors, are more easily affected, but show less macroscopic damage than other tissues.

The findings may be those of asphyxia, congestion with or without ecchymosis of the cerebrum, medulla or cord and their membranes. Heart is flaccid; the right heart filled with fluid blood, the large venous trunks and veins congested, arteries contracted and nearly empty. Blood not coagulated or poorly coagulable. There may be ecchymosis beneath the pericardium, pleura, or in the lungs. Evidence of violence or injuries before mentioned may be found in the skin, muscle, bones or viscera. There are no reliable or constant cytologic changes in the material obtained from cases of death by lightning.

Case 1.—On August 3, 1916, Miss V. and Miss A. were sitting on the porch of their cottage, which was located among the pine trees on the slope of a hill near Grand Lake, Colorado. A severe storm began and they went into the cottage.

Miss V., noticing the rain coming in the window of her room, closed it, but not before the floor became wet. She then sat on a commode. The commode was several feet from the bed near the living-room partition, on the opposite side of which was a stove with a metallic flue leading through the roof. The next thing she knew she was lying partly under the bed near a large hole in the floor. She experienced no pain, and did not know what had happened or how long she had been unconscious. She says it could not have been long, probably a few minutes. When she tried to get up she no-

ticed the front of her shoe was torn, and the sole and heel entirely gone. The little toe was gone, and her foot was bleeding badly. She called to Miss A., but received no response.

Miss A., who had been sitting in a chair near the middle of the living-room, heard Miss V. close the window and remark about the storm. She heard nothing after this, but saw the stove lid fly across the room, and heard it fall on the floor. Above the stove appeared a huge round flash of bright light, the size of the sun. She tried to get up, but was lifted from her position and thrown several feet through the open door to the floor of her room. She was dazed; her ears felt shut. She was aroused after a brief period by the cries of Miss V., which she heard as if in a dream. She could not move. By supreme effort, being unable to get up, she crawled to Miss V.'s room, and found her sitting on the floor holding her foot. The sight of the blood all over the floor brought her out of her dazed condition. She laid Miss V. on the floor, who, on looking up through a hole torn by the lightning in the ceiling, saw the cottage was on fire. The cottage burned completely. The near-by pine trees were also burned. Miss V. was carried to the adjacent ranch-house, and was attended by Dr. H. L. Buxton, who rendered efficient service, stopping the hemorrhage, which seemed to threaten her life. Her watch stopped at 2:10 P. M., the exact time of the stroke.

I was sent to Grand Lake by Dr. G. W. Holden, and arrived the next morning. Miss A. was entirely recovered, though still very nervous, a state easily accounted for by the precarious condition of her friend, Miss V. Miss V. was in a state of shock, under the influence of opiates. The lips were cyanotic, the skin pale, giving the face a peculiar expression. The pulse was 140; respiration, 14 and irregular. Her left labium showed a superficial laceration the size of a quarter. Her left foot had a laceration, the surface of which appeared as if seared by heat, and extending through the web between the big and the second toe from the dorsum to the plantar surface of the foot back to and exposing the first row of tarsal bones. There was a second laceration through the web between the second and the third toe through the entire thickness of the foot joining the first laceration near the base of the metatarsal bones. A third laceration two inches long through the web between the third and the fourth toe

involved the dorsum of the foot and the intermetatarsal tissues. A fourth laceration through the web between the fourth and fifth toes extended across the base of the little toe, completely amputating it, leaving only a fragment of the proximal phalanx. On the dorsum of the foot near the base of the second and third toes was a nearly circular burn of the second degree, the size of a silver half-dollar. On the corresponding area of the sole was a burn of the same size and degree. Extending from two inches below the internal malleolus under the heel to its outer margin was an irregular laceration through which could be felt fragments of the fractured os calcis. One of these fragments had the posterior end of the badly shredded plantar fascia attached to it; two others were removed. There was a comminuted fracture of the lower end of the tibia and fibula, compound comminuted fracture of the os calcis, and fracture of the third and fourth metatarsal bones, as shown on the accompanying *x*-rays by Drs. Childs and Crosby.

Without anesthesia the wounds were gently wiped free of coagula with dry gauze. The plantar fascia, which was reduced to a bundle of strings, and the deeper tissues were united by tiers of interrupted catgut sutures, two catheter-drains inserted, the skin loosely approximated with interrupted silkworm sutures, and the leg placed on a posterior splint. The patient withstood the ordeal with wonderful fortitude. She was sent to Denver the next day. For three days her temperature was 100°, but never higher. She had severe darting pains in her back, leg, and foot. Tactile sensation in the foot and leg was normal. At the end of a week I sent her to her home in Chicago, and reports tell of her favorable progress. She can now bear considerable weight on her foot, which is practically healed.

REPORT OF TWO CASES OF MALIGNANT CERVICAL TUMORS ARISING FROM THE CAROTID BODY

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The inspiration for my subject dates back to 1906, when, at the Boston meeting of the American Medical Association, it was my fortune to hear closely the address of W. W. Keen, which has since become a classic on this topic, and is preserved in full in the *Journal of the A. M. A.,* vol. 16, 1906. In this address he presented 1 case of his own, and reviewed fully 29 others recorded in surgical literature up to that time, 1906. An equally exhaustive continuation of this subject up to 1913, with 31 additional cases, making 60 reports in all, is that of Callison and MacKenty, of Philadelphia, in the *Annals of Surgery,* of December, 1913. A few more have been added since. Murphy's Year-Book of 1916 notes 3 cases in the last three years.

I wish, in the short time of my paper, rather to present a view of the two excellent studies quoted above, adding 2 cases of my own observation with a few personal deductions, which appealed to me, and, I trust, may be helpful to some others who may not have met this condition.

Anatomically, we find the carotid body appearing somewhat inconstantly in the embryo, as a bean-shaped mass 20 to 30 mm. long, half as wide, firm, elastic,

rather nodular, color a reddish-gray to a reddish-brown, and lying just posterior to the bifurcation of the common carotid artery, attached closely to it or one of its branches, or both, by the ligament of Mayer, which also carries its own blood supply.

Histologically, they are composed of large polyhedral cells, epithelioid in character, with clear protoplasm and large well stained nuclei.

The nerve supply is markedly abundant, coming from both the cranial nerves, the vagus and glossopharyngeal and the cervical sympathetics.

Physiologically, no function has been definitely proven nor any internal secretion, and the gland usually disappears at birth. About the only possible interest appears, then, in the occasional *persistence,* after birth, of the body, and, when so persistent, with a tendency at sometime in later life to take on growth, and a marked tendency to a moderate malignancy which follows in most of the cases reported, after a long period of quiescence or of benign history.

Pathologically, they are reported usually as sarcoma, endotheliomata, or peritheliomata, in type.

The position of the gland, when occurring, is quite constant. It lies just behind the carotid at its bifurcation, and, when growth occurs, it is necessarily forward and usually includes large vessels, as well as the trunks of the vagus and glossopharyngeal nerves, more or less in its growth.

A brief description of the cases of Keen and Callison would rather typify the class. Keen's patient presented a tumor, 13 cm. long by 10 wide, movable laterally, but not vertically, firmly attached to the deeper tissues appearing from under the anterior border of the sternomastoid muscle at the level of the thyroid cartilage, extending upward toward the mastoid. He first regarded it as a lipoma, and recommended its re-

moval because of the extreme symptoms complained of by the patient,—difficulty in swallowing, a certain retraction of the head, and certain subjective symptoms besides. On exposure he recognized his error, and believed it to be a tumor from the carotid body. He found it necessary to remove the mass entire, including the carotid, and he dissected out the nerve-trunks with great difficulty. He notes especially the hemorrhage, requiring in all over sixty ligations. The patient rallied fairly well, but died two days later from an acute pulmonary edema.

In the 29 other cases collected at that time 26 were operative and 3 at post-mortems, but previously diagnosed.

Of the 26 patients operated on, 7 died, mainly from secondary complications, such as hemorrhage, pneumonias, and cerebral anemias.

One of these early cases reported, was from the University of Iowa, in 1895, operated on successfully by Dr. Middleton, with a pathological report by Dr. Bierring. The patient was a man, aged 45, who suffered four months later a fatal recurrence on the opposite side of the neck.

Callison and MacKenty's patient was a male, aged 43, Irish, a driver, muscular and angular in build, and weighing 170 lbs. He presented himself with a tumor in the same region noted before of six weeks' recent growth and accompanied by a loss of 20 lbs. in weight, and a train of symptoms again out of keeping with the apparent severity of the affliction. On removal the tumor was 14 c.m. long by 10 wide, and encapsulated, the growth including the common carotid artery and the internal jugular vein. The cranial nerves, as before, were all dissected out with great difficulty, but *without* ligation of the large vessels. Pathologically, it was pronounced an endothelioma.

In their review of the 60 cases, to that date (1913), 54 had come to operation, and 4 were found so bad that removal was not attempted; 42 recovered from operation; and 12 died, 4 from pneumonia following a divided vagus; 3 from hemorrhage, 2 from cerebral anemia, 1 from acute pulmonary edema, and 3 from secondary infection and general causes. Of the 42 recoveries, 4 had hemiplegia and aphasias; 4 had permanently impaired voice from laryngeal paralysis; 1 had a constant irritating cough, and 4 had focal paralysis of the neck and shoulder. Practically all cases had a history of long benign existence of very slow growth, then suddenly taking on an active growth with a varied and interesting train of symptoms, local, bodily, physical, and psychical. If removed early, before extra capsular invasion occurs, they do not return.

The age distribution of the cases was as follows:

20 years of age, 3 cases.
20 to 30 years, 13 cases.
30 to 40 years, 12 cases.
40 to 50 years, 14 cases.
50 to 60 years, 10 cases.
Over 60 years, 6 cases.

As to sex, there were 31 males, 21 females, and 1 not stated.

As to my own cases observed, one appeared on March 4, 1916, a farmer, large and gaunt, muscular, a German, aged 45, presenting a tumor in the right cervical region opposite the thyroid cartilage, in size, about 8 cm. long by 6 wide, irregular in outline, and quite firmly fixed in the deeper tissues, and transmitting a definite carotid pulsation. He, too, complained of much distress in swallowing and breathing, and his voice was a rasping whisper, and he complained generally of much ill feeling and distress quite out of keeping with the evident local trouble

alone. His attention had been called to a growth in his neck seven months before, since which time he had lost 25 pounds in weight. His general appearance suggested a probable pulmonary trouble, as well, which naturally would lead one to the conclusion of a local tubercular gland as the basis of his cervical trouble, but, on studying the case, I was again reminded of Keene's vivid description in 1906.

At operation I found a semi-encapsulated mass, irregular in outline, embracing the common, internal, and external carotids, and the internal jugular vein, and requiring dissection from the jugular depression quite up to the mastoid process. The hemorrhage was very troublesome, but by temporary occlusion of the large vessels I was able to finally free them without removal after an hour's careful dissection, and I have here the tumor in part for your examination. It was submitted to Professor Albert, pathologist at the University of Iowa, who reports it, in his belief, to be an endothelial sarcoma, and, from its position and relationship to the carotid vessels, arising from the carotid body.

The patient had a rather slow recovery of general health, but reported later much improved and having regained his 25 pounds in weight. The voice is still very husky, and with some of his various head-symptoms still complained of. He has some persistent cough, and difficulty in swallowing at times. Some deltoid paresis, and much general disappointment and complaint that he is not made whole in every respect from what he still regards a simple and common affliction, originally.

The second case was in a man about 42, who in 1908 appeared in our Clinical Service of the Department of Surgery at the University of Iowa. This man presented less secondary general or remote ef-

fects from his growth, but the local symptoms and features were much as were the type now recognized in character. His personal or family history was otherwise negative. We recognized the growth, which was removed by Professor William Jepson, as my chief; the recovery was successful, and, so far as I know, it has not recurred, but I have not the very recent history of the case. The tumor was reported by Professor Albert as an endothelial sarcoma arising from the carotid body. From my own and the reported cases, I wish to speak briefly of what I deem the most important practical points.

As to diagnosis: Keen says their diagnosis is very difficult because of their rarity, not usually mentally included, in the number of far more common conditions, from which they must be differentiated.

First, from the common benign growths of the neck, as lipomas, fibromas and other common growths and inflammatory conditions.

Second, primary malignant growths or glands metastases of the same elsewhere.

Third, from syphilitic nodes or gummata.

Fourth, from branchial cysts, dermoids or other embryonal rests.

Fifth, from aberrant thyroids.

Sixth, from Hodgkin's disease or allied glandular invasions.

Seventh, most frequently and important, I believe, from tubercular glands. Especially of that type where we find the solitary gland normally near this region—the carotid bifurcation often running a similar chronic or benign course and later undergoing degeneration, with secondary infection, and in which the personal history sometimes bears marked resemblance, as well as the simulation in the temporary external appearance, but herein let me especially warn of the operative

differences to be found between the two. The one is a simple procedure; the other, a condition which may tax our energies to the utmost and is liable to give us unlimited trouble unless previously anticipated and prepared for.

As to treatment: Naturally, we would say removal in all cases and that early, during the benign stage in which they do not recur. But Keen, after his experience, differs from even this, and says that, considering the danger and difficulty of removal and the frequent injury to nerves and vessels in all cases, and the failure to relieve ofttimes the distressing attendant symptoms, unless the presence of the tumor is actually and directly responsible for the symptoms, or positively dangerous from malignant invasion, he would not advise removal, and would do so in no case for cosmetic reasons alone. If removal is imperatively demanded, he would, in all cases, prepare for nothing less than a complete and wide dissection, including resection of the carotid vessels and jugular vein. Less than this is immediately dangerous, and ultimately in many cases inefficient from recurrence.

Others regard this course as greatly extending the dangers of the operation in the after complications which are so prone to occur in carotid resections, and to have been responsible for the high mortality in the recorded cases. The two cases I have reported were both apparently successful as to recurrence and life-saving, but as to relief of symptoms, only moderately satisfactory.

Again I would urge upon those who may not have had personal experience with them, two points which I regard as of vital importance: First, that we always keep them in mind in all growths arising from this especial region around the bifurcation of the common carotid artery, and, if even suspected in

diagnosis, that sufficient assistance and a thorough operative preparation be instituted and carried out, for it will save much discomfiture and perspiration on our part, and danger to the patient. Secondly, that you fortify and protect yourselves against future trouble and annoyance, as well as possible legal responsibility, by warning your patient of the probable continuation of some of his symptoms; of the dangers and difficulties in the removal; of the proneness to paralysis and aphonias, and various other nerve effects which may persist or follow either from the operation itself or the previously existing changes already undergone in these structures. But woe unto him who may have inadvertently referred to it as a small matter, or have assured the patient of a simple operation and sure results with relief from any or all of his complaints.

DISCUSSION

Dr. J. E. Moore (Minneapolis): I had the pleasure of hearing Dr. Keen's paper which he read before the American Medical Association at the meeting in Boston. I was greatly interested in his paper, and thought that was one of the conditions we should have in our memory because of the possibility of meeting it. I had never met a case until that time, but within the past year we have had experience with one such case in the University Hospital at Minneapolis. I was sent for one day to go to the operating-room of the hospital in consultation, and I found one of the younger members of the staff operating. He had the prettiest live dissection of the neck I had ever seen. Both branches of the carotid and the common carotid, the vagus, and the internal jugular were each dissected out separately. There was a mass right over the bifurcation of the carotid which was dark purple and pulsating. The operator wanted me to assure him that it was not an aneurysm before he proceeded further. We said it was a tumor of the carotid body.

This patient came to us at an early period, and was brought for unusual reasons. She was not suffering very greatly. The tumor was not large. We made a tentative diagnosis

by exclusion. We got it down to two things. We were certain it was either a tumor of the carotid body or a branchial cyst, with the emphasis on the first diagnosis. The patient came, however, on account of her family history. There had been one member of the family (whether a brother or sister I do not recall) who had been operated on for a tumor in this location, presumably of the same character, a number of years before, and died following the operation. Another member of the family was successfully operated on at the Mayo Clinic. I have learned since that the tumor was a tumor of the carotid body.

When I came to the operating-room, the operator had already gone so far as to make an opening in the jugular vein which he sewed up and which gave no subsequent trouble. Then the question was how to proceed. The tumor was vascular, as seen by the pulsation. We concluded the better plan would be to ligate temporarily the common carotid. A compression by stomach forceps was made on the common carotid, and a careful dissection was done with the knife. We soon learned why there was so much pulsation in that tumor. It received its blood supply from the internal carotid and external carotid by special branches running directly from the various arteries into the growth. It required many fine ligatures of silk. The tumor was dissected from the vagus and internal carotid with the knife. After the tumor was removed, it was not much larger than my thumb. The subsequent history was uneventful. The patient made a prompt and satisfactory recovery.

The majority of the pathologists to whom we sent sections of this tumor said it was an angiofibroma, but I have not learned since what the pathologic findings are because the specimen is in the pathology building, which is over on the other side of the campus.

Later report: The pathologists report that this is a typical carotid tumor, and they suggest that the term "paraganglioma" might be used in its classification.

Dr. J. F. Binnie (Kansas City): I also had the pleasure of hearing Dr. Keen's paper years ago in Boston. At that time I was very anxious to discuss the paper, but I did not do so because I was ashamed of my city. In those days, twenty years ago in Kansas City, no records of cases were kept by the City Hospital. I saw a case which was diagnosed as cervical tuberculosis, and was operated on. During the

operation I recognized the condition present as being what the clinician calls a body-like tumor of the neck. I removed it. Dr. Frank Hill made a pathologic diagnosis, which confirmed my idea that it was a tumor of the carotid body. The patient recovered from the operation and disappeared.

I did not report the case in connection with Keen's paper, although there did not seem to be any one at the meeting who had ever seen a case except Dr. Keen.

Dr. J. F. Percy (Galesburg, Ill.): I have had three of these cases, and two of them have not been operated on. They come to us every once in a while to see about operation, and I think I frighten them away because I cannot promise that I will not paralyze the face, if they are operated on.

One operation was done seven years ago. The patient was a very fat woman, and had an enormous tumor under the ear. She has had no recurrence since, and the only trouble that I encountered, except the ordinary difficulties of the operation, was that I pinched one of the seventh pair of nerves, and for a while she had paralysis of that side of the face.

The other two cases I have mentioned do not have as large tumors as the one just spoken of. The pathology in the case operated on was worked out by Dr. Wm. H. Welch, of Baltimore, who reported a tumor of the mixed-cell type.

Dr. W. T. Coughlin (St. Louis): I would like to ask the essayist whether he can tell whether these tumors metastasize or not. I know they infiltrate. I had one case. The tumor was removed, but the jugular vein and the vagus nerve and the carotids, all three, were incorporated in it, so that it was impossible to separate it, and it necessitated excision of the common carotid and two branches of the carotid. The patient did very well for twenty-four hours, when he became suddenly paralyzed on the left side (the tumor was on the right side), and he became delirious, and died at the end of about forty-eight hours.

Dr. Burge (closing): I would say, in answer to the question of Dr. Coughlin, that these tumors seem to be regarded as moderately malignant. Some two or three have been reported as having metastasized generally, but, as a rule, they recur locally with direct spreading.

CYST OF THE ADRENALS: REPORT OF A CASE

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I have written this paper to call attention to a rare surgical condition, adrenal cyst, occurring in the upper abdomen, and more frequently recognized at post-mortem examination. It seems quite probable from a review of the literature that many cases occur unrecognized in early life. Hemorrhage is the foundation of the pathogenesis of adrenal or suprarenal cysts. It is fair to suppose that these hemorrhages are not always of a severity sufficient to cause death or even a noticeable tumor. We all know the liability of blood-clot to become infected and to break down; therefore, in many cases these hemorrhages, while not going on to the formation of true blood-cysts, may be the foundation of various vague abdominal symptoms, unexplainable by their symptomatology, and may even be the cause of perirenal abscess, which we all know is often unexplainable in origin.

The fully developed cyst is usually, as in my case, only recognized when the hemorrhage has been repeated from time to time, and operation is at last done for a demonstrable tumor. This condition of suprarenal hemorrhage being concealed (retroperitoneal) not showing in any excretion of the body, must of necessity be occasionally unrecognized in its early stages, and may often, if suspected and looked for,

be recognized as the foundation of phenomena otherwise quite puzzling to the examiner.

On December 5, 1915, I was called by Dr. William Lothian, of Kansas City, to see Miss P., who had developed a most alarming trouble in the region of the gall-bladder, but whose symptoms were of too violent a nature to be attributed to stone. I found the patient with pulse of 100. The doctor stated that the pulse was 84 an hour before. The rising pulse was accompanied by pain of an agonizing character and by difficulty of breathing. The temperature was 97.° She had developed within the last three days a tumor under the eighth rib in front. December 5 was Sunday, and she first noticed the tumor on Wednesday before. The tumor was bulging forward, and was arched above with curving line corresponding with the diaphragm. The tumor was dull on percussion, and seemed to be fluid on the right and solid on the left. On the left the dullness extended beyond the middle line some four or five inches, and on the right the area of dullness seemed wider, going out to the border of the abdomen and extending from the rounded margin above downward below the level of the umbilicus. The rapid pulse, rising steadily, was accompanied by all the evidence of shock. Her face was livid and her breathing labored, so that obtaining a history was a matter involving some difficulty. She was waitress in a restaurant, and carried heavy trays on her left arm. The present attack had come on after she had served a dinner. It commenced with pains and with faintness on Saturday. She had had several previous attacks of acute pain with shock, the pain being on the right side high up. One doctor had called it "gall-stones"; another had given the diagnosis and treatment of "pleurisy." She thought there were five or six attacks, the worst being in the previous

August (1915). No other attack had equaled or approached this attack in severity. The patient's pulse, which Dr. Lothian had found to be 84 at 7:30, and which I found to be 100 at 8:30 P. M., was 120 at 9 P. M., and I awaited her consultation with friends and her consent to open the abdomen. When at 9:30 the pulse reached 140 with severe pain, shock, and dyspnea, she consented to operation.

Operation, 10:30 P. M.: Incision in the right semilunar line. A blood-cyst presented. The cyst was as large as an adult head, or larger. It had crowded the liver to the left. The liver itself and the gall-bladder were quite normal other than such changes as the pressure and dislocation by the cyst might be expected to cause. The stomach and duodenum were identified, and were not attached to the cyst. They were forced downward and to the left. The tension caused by the displaced liver against the lesser curvature of the stomach was somewhat severe. The ascending colon was displaced with the stomach and duodenum. The right kidney was felt below the tumor closely associated with its deep attachment or origin, but not a part of it. The pancreas could not be felt. The cyst was at once incised, and found to contain about two quarts of bloody serum and about two quarts of clots. The wall of the cyst contained many little warty growths. They appeared all over the inner aspect of the cyst-wall as small sessile growths, varying from one-eighth to one-third of an inch in diameter and of irregular outline. Beyond these patches the cyst-wall was of peritoneum, apparently the parietal peritoneum covering a hematoma forced upward from below.

As stated before, about two quarts of bloody fluid or serum was first evacuated, and afterward several double handfuls of clots. Then appeared in the bottom of the cavity a lumpy mass, which I quickly scooped out with my gloved hand. It was a whitish, soft, disintegrated mass that proved to be an old hemorrhage. A bleeding vessel was found beside it, clamped, twisted, and dropped. The sac was fastened into the wound and packed with gauze.

The entire procedure was abbreviated in every way owing to the alarming condition of the patient; otherwise much more valuable information might have been gathered by a careful study of the surroundings and the relations of the cyst. The patient made a good recovery and a prompt convalescence.

With a view of determining the possible nature of the patches on the inner aspect of the cyst wall I excised a portion of the membrane, and referred it to Dr. Trimble for examination. He reported nothing of a malignant nature. The patches or warty growths proved to be granulation tissue on the peritoneum. The patient remains well one year after operation.

Henschen states that, prior to 1906, there were only seven cases of large blood cysts of the adrenals recorded in the literature, and that of those only four were subjected to operation as follows:

1. Pawlik, 1894: woman, aged 40; left side; five years' duration. There was a history of slight insignificant trauma. The cyst contained ten liters of bloody fluid, besides shreds of tissue. Blunt enucleation of cyst sac. Lumbar drainage; recovery; patient well two years later.

2. Routier; 1894: woman, aged 36; left side; no history of trauma; marsupialization. Adhesions to pancreas and spleen precluded enucleation. Contents, 3 liters. Death five days later. Autopsy showed cyst of the left adrenal.

3. Bier; 1901: woman, aged 69; right adrenal cystoid size man's head. Contents 2 liters of dark fluid and detritus; marsupialization. Death in a few hours.

The autopsy revealed that it would have been easy to enucleate. There was pressure atrophy of the right liver-lobe to the extent of 1 cm. thickness. Right kidney was dislocated on to the ilium.

4. Kronlein; 1905 (Henschen's case): woman, aged 41; left adrenal cystoid, larger than a man's head. The cyst communicated with the left pleural cavity. History: twenty years ago pleurisy (left); three years ago, puerperal venous thrombosis in left leg; recently, polyarthritis, subsiding under salicylates. She was pale. There was no history of trauma. Enucleation. Cyst contents were chocolate colored. Death in five days.

Henschen states, "I have found four additional cases in this class (including my own), namely:

5. Terrier and Lecene: woman, aged 52; attacks of pain in umbilical region; oval, smooth distinctly fluctuating tumor, size of ostrich egg, in left groin. Operation (Terrier): median incision above the umbilicus; enucleation of tumor easy; only half of it removable, being taken for pancreatic cyst.

Contents,—lemon-colored fluid. The thin wall contained suprarenal tissue; right parotiditis, fifth day. Recovery. No fistula in cicatrix.

6. McCosh: woman, aged 45; three years dull pain radiating from left loin; severe attacks of lancinating pain; slight bronzing of the skin.

Operation: complete enucleation of universally adherent cyst attached to the aorta and bodies of lumbar vertebræ; contents nine pints of dirty-yellow fluid; force pressure and drainage. Recovery. Bronzing of skin disappeared. The thick cyst-wall contained adrenal tissue.

7. Doran: woman, aged 62; left side; sharp pains, aggravated at night.

Operation: vertical incision through outer edge of rectus muscle; enucleation; contents of the thick-walled cyst, one-half pint bloody fluid and broken-down tissue. Recovery. There was no indication of adrenal tissue to the naked eye, yet microscopically such tissue was readily recognized.

My case then becomes case the eighth of uncomplicated adrenal cysts of adults.

There is no case we have been able to find recorded between the case of Doran, reported in 1906, and the present report (Pearse), in 1916.

The following references are included in the paper because they show a close and important relation to the subject. For example:

Reference No. 3 Lockwood.

Doubtful large blood-cyst from Wolffian body; operation; recovery.

Reference No. 4. Wendel.

One blood-cyst after injury of unknown origin.

One ditto in a solid tumor of adrenal.

Reference No. 5. Schilling.

Case of blacksmith, aged 22; right-sided adrenal cyst. Contents, pus and blood,—several liters. Incision and drainage. Interior of the cyst, abscess-cavity everywhere lined with a smooth wall, except the bottom of same, from where soft adrenal tumor tissue was removed. The microscopic report was endothelioma or parathelioma or lymphangioma of adrenal body. It was evidently not sarcoma, for the young man was in ex-

cellent health and without recurrence 11 months later. It was the conclusion of the clinician, as well as of the pathologist, that the new formation was from the blood-vessel walls of the adrenal body with hemorrhagic cyst-formation and suppuration thereof.

Reference No. 10. Sick.

Post-mortem: small lymph-cyst of adrenal, containing in two recesses ciliated and columnar epithelium.

Reference No. 11. De Veechi.

Post-mortem: bilateral adrenal lymph-cysts.

Reference No. 12. E. Hedinger.

Post-mortem: "struma medullaris cystica suprarenalis."

Reference No. 13. W. Nowicki.

Post-mortem: lymph-cysts of adrenal.

Reference No. 14. H. Rimann.

Large retroperitoneal hemorrhagic cyst of unknown origin. Operation. Recovery.

According to most authors on embryology, the adrenals develop from a mesenchymal anlage and from a sympathetic ganglion. These anlages unite closely very early in embryonal life. Chromaffin tissue is assigned to them in common with a group of organs producing internal secretion. The adrenals secrete a substance which produces contraction of unstriped muscle, and whose principal function seems to be to maintain the blood-pressure and vascular tonus at corresponding levels. In fetal life the adrenals are relatively much larger than in the adult, so that at birth the kidneys are about three times heavier than the adrenals. In the adult the kidneys weigh over 40 times as much.

The yellow cortex is composed of large epithelioid cells, which become smaller towards the medulla. Under its fibrous capsule the cells are arranged in oval masses (zona granulosa); under this is a layer in which the cells are disposed in a broader cylindric manner (zona fasciculata); then come anastomosing rows of cells (zona reticularis), which cannot be sharply separated from the medulla. Between the radiating cell-masses run connective-tissue partitions

containing blood- and lymph-vessels; and capillaries also run between the adjacent cell-groups. The outer cortical cells usually contain fat, while further inwards are found pigment granules that stain brown with chromic preparations.

The cells of the medulla are polygonal and oval, but their outlines are hard to make out. Some are said to be branched. When fresh they stain brown from chromic solutions. The medulla contains relatively large blood-vessels and blood-sinuses, which receive the arterioles and capillaries from the cortex and empty into the central vein. This vein is surrounded by a mass of smooth muscular tissue. The sinuses have thin walls of endothelial cells. Adrenal cells have been absorbed in the sinuses and adrenal vein. The medulla contains numerous nerve fibers, ending in fine intercellular fibrils. Ganglion cells occur in and upon the capsule and in the medulla. This structure especially lends itself to early and severe hemorrhage upon slight trauma.

Accessory adrenals, first described by Rockitansky, are frequent. They are found oftenest in the connective tissue about the main adrenals, but also in the kidneys, right lobe of the liver, along the renal and spermatic veins, and in the inguinal canals and broad ligaments. Accessory adrenals, or rests, are yellowish in color, and vary in size from the microscopic upwards; their number also varies. Those near the main organ are often connected with it by fibrous strings. In the kidney they are found rather frequently, especially near the cortex, as small round masses, which may undergo fatty degeneration. Minute adrenal rests may contain cells recognized as cortical; when larger they may have distinct cortex and medulla. They may undergo compensatory hypertrophy on removal of the main adrenal, and they may

become the origin of tumors in kidney, broad ligaments, etc. There were no adrenal elements noted in my case.

Hemorrhages are frequent in the adrenals of the new-born, much less so in the adult. Le Comte collected 33 double, 8 right, and 11 left cases. When larger hemorrhages in the adrenals are not absorbed, they become encapsulated as hematomas. In their connective-tissue walls, and sometimes also in the interior, are deposited lime salts, while slowly resorbed blood-elements are replaced by fluid; thus results an increasing cystoid resemblance.

It appears that more frequent microscopic search of walls of encysted retroperitoneal hematomas may add valuable information concerning pathogenesis, relative frequency, earlier diagnosis, and more conservative treatment of hemorrhagic cystoids of adrenal origin.

I wish especially to suggest that the accessory adrenals undergoing hemorrhagic and blood-cyst formation (to which changes they are especially prone) may account for many of the hematomas about the tubes, broad ligaments, and ovaries of the woman in whom ectopic pregnancy is diagnosed, but no fetal structures are apparent. Search for tissue of adrenal origin might be rewarded by a better diagnosis.

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SURGICAL TREATMENT OF BANTI'S DISEASE, WITH A REPORT OF THREE CASES

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Surgery of the spleen has received a great impetus in the past five years; and a sufficient number of splenectomies have now been performed to establish a fairly secure basis for determining the indications and value of the procedure. My contribution is based upon a careful review of the literature and upon personal observation in three cases of Banti's disease, splenectomized and herewith reported.

Dr. G. B. Johnstone, in an exhaustive résumé of this subject, in 1908, reviewed all cases of splenic anemia, 61 in all, treated by splenectomy up to that time. In that number there were 49 recoveries and 12 deaths—a mortality of 19.5 per cent. I have endeavored to collect all cases reported since 1908, and I add three cases of my own, with recoveries in all of them. Observation of my own cases and a study of those reported in the literature of the past few years, lead me to believe that the term "splenic anemia" best designates the various phenomena accompanying this disease; and, as suggested by Rodman and Willard, three stages may be recognized.

The first stage, often extending over a long period of years, is characterized by splenomegaly, anemia, gastro-intestinal hemorrhages, and pigmentation of the skin. The second stage, of short duration, gives

only the added symptom of renal insufficiency. In the third or terminal stage, the dominant feature of the disease is the failure of liver function, with marked ascites and extreme emaciation. The symptom complex described by Banti, applies especially to the ascitic stage of the disease. Two of my cases fall in the third stage of the disease, and one belongs in the second stage. All three cases showed greatly enlarged spleens, anemia of the secondary type, leucopenia, and pigmentation of the skin. There was no etiological factor common to all three cases. All denied syphilis, although one case gave a positive blood Wassermann.

Operative Technic.—A long, left-rectus incision was found entirely satisfactory for the removal of all three spleens, although two of them were very large, and many adhesions were encountered. After the adhesions were separated, the spleen was quickly delivered from the abdomen by encircling it with the forearm and elbow, much as one would pick up a large watermelon with one arm. Much time may be lost by futile attempts to deliver a large spleen by grasping the edge with the fingers or with instruments. Attention has been called by Dr. W. J. Mayo to the importance of ligating the splenic artery before constricting the veins. Much blood is thereby saved the patient. In my second case, a huge spleen, the vessels were clamped simultaneously, and the spleen removed before ligation was attempted. The organ was very vascular, and contained a large amount of blood. Fortunately, it was thrown into a large sterile basin. When the clamp was removed from the vessels attached to the spleen, about a liter of blood escaped into the basin. Dr. Harlan Shoemaker, who was watching the operation, suggested that the blood lost from the spleen be reintroduced into the patient's veins. I promptly acceded, and within ten minutes,

750 c.c. of the patient's own blood was filtered, citrated, and reintroduced into his veins. This procedure of autotransfusion was thought to be original, but I found that Lichtenstein has reported eight cases of ruptured extra-uterine pregnancy and one of rupture of the uterus, in which blood was scooped out of the abdomen, defibrinated, diluted with salt solution, and reintroduced into the patient with brilliant results. In both of my cases, autotransfusion proved of striking value.

REPORT OF THREE CASES:

CASE 1.—M. R., male, aged 27, caucasian; occupation, brakeman. Chief complaint, weakness, anorexia, dull, heavy sensation in the abdomen, bleeding from the bowels, vertigo at times.

In September, 1912, when apparently in perfect health, the patient said his bowels filled with blood, and he passed a large amount of black, tarry, foul-smelling material from his bowels. This was accompanied by deep, heavy pain in the lower abdomen. From this time until December, 1915, he was able to do only light work. He tired easily, and had constant heavy feeling in his lower abdomen.

One week before entering the hospital, he had severe hemorrhage from the bowels, accompanied by sharp pain in the abdomen. He also spat some blood at this time.

Family history: negative; no serious illness, denied venereal disease.

Habits: drinks an occasional glass of beer, smokes tobacco.

Physical examination: thin, anemic, young man. Head, negative, except for pyorrhea and decayed teeth. Chest, negative, except for pulsation of the vessels of the neck. Abdomen,—liver slightly enlarged, symmetrical abdominal distension; fluid in the peritoneal cavity; splenic tumor extending two fingers-breadth below the umbilicus; genitals and extremities, negative; reflexes, normal. Wassermann, positive.

Blood examination, December 14, 1915:

Hemoglobin, 43 per cent.—Tallquist.

Color-index, 8

Erythrocytes, per c.mm., 2,480,000.

Leucocytes, per c.mm., 6,800.

Hemoglobin, 25 per cent.—Von Fleischl.
Color-index, 6
Erythrocytes, per c.mm., 2,100,000.
Leucocytes, per c.mm., 11,800.
Polymorphonuclears, 80 per cent.
Lymphocytes, 14 per cent.
Large mononuclears, 4 per cent.
Eosinophils, 2 per cent.
Poikilocytosis, marked.
Size, variable.
Macrocytes, positive.
Microcytes, positive.

Operation, January 4, 1916: splenectomy and omentopexy was performed through the left rectus incision. The abdomen contained a large amount of straw-colored fluid. During the closure of the incision, one quart of normal salt solution was given under the breast.

Post-operative history: Prompt recovery from operation, with temporary improvement in general condition, and then gradual failure. There was no return of hemorrhage. January 10, 1916, six days after the operation, the blood picture was as follows:

Erythrocytes per c.mm. 3,100,000.
Leucocytes per c.mm. 27,200.
Differential count stain, Wright method, air:
Polymorphonuclears, 41 per cent.
Lymphocytes, 24 per cent.
Large mononuclears, 33 per cent.
Poikilocytosis, absent.
Size, 5-14.
Macrcocytes, positive, few.
Remarks,—coagulability increased; color of red cells, pale.

Blood examination, January 16, 1916; twelve days after operation:

Hemoglobin, 60 per cent. estimated; color-index, 12.
Erythrocytes per c.mm. 3,150,000.
Leucocytes per c.mm. 24,000.
Differential count:
Polymorphonuclears, 64 per cent.
Lymphocytes, 5 per cent.
Large mononuclears, 18 per cent.
Eosinophils, 4 per cent.
Poikilocytosis, none.

Macrocytes, positive.

January 24, three weeks after operation:

Leucocytes per c.mm., 13,400.

When the patient was last seen, in October, 1916, he was extremely emaciated, and had marked ascites. He was being tapped twice weekly, and as much as three or four gallons of fluid withdrawn.

Laboratory record: The spleen measured 5 by 15 by 24 centimeters. Microscopic examination: increased connective-tissue stroma; many young leucocytes in the vessel spaces. Pathologic diagnosis: hypertrophied and engorged spleen.

Case 2.—John S., aged 31. Principal complaint was weakness, periodic headaches, alternating diarrhea, epistaxis, and occasional jaundice.

Previous diseases: malaria at 13 years of age, measles, and chicken-pox, gonorrhea, denies syphilis. Habits: steady, moderate drinker, smokes and chews tobacco, no drug habit.

Physical examination: Well nourished; subicteric tinge to the skin, mucous membrane pale; abdomen,—distended, epigastric tenderness, the liver extended two fingers below the costal margin, splenic tumor reached almost to the brim of the pelvis; examination, otherwise negative.

Wassermann of the blood negative.

Blood-picture before the operation:

Erythrocytes per c.mm., 3,100,000.

Leucocytes per c.mm., 6,400.

Hemoglobin, 80 per cent.

Differential count, 200 cells:

Small mononuclear, 30 per cent.

Large mononuclear, 9 per cent.

Indentate nucleus, 3.5 per cent.

Polymorphonuclear, (Neutrophils) 5 per cent.

Polymorphonuclear, (Eosinophils) 2.5 per cent.

Urine, normal.

Operation, April 16, 1916: Splenectomy and omentopexy. Intravenous infusion of 750 c.c. of citrated blood recovered from the spleen.

Pathological examination of the spleen: gross examination of the spleen, about five times normal size. Smears taken.

Microscopic examination: smears show many small mononuclear leucocytes and a few polymorphonuclear cells, also eosinophiles. Sections,—the capsule is thickened; malpighian corpuscles are on an average a little larger than normal; the

trabeculæ are normal, and the spleen pulp is replaced in many areas by connective tissue.

Dimensions,—8 by 14 by 22 cm.; weight, 2 lbs. 11.5 oz.

Post-operative history: Patient made an excellent operative recovery, but complained of much abdominal distress and for a time grew weaker. He then gradually improved, and left the hospital much stronger. He has continued to improve with slight remissions, and is now able to do light work.

Blood-picture June 12, 1916:
Hemoglobin, 65 per cent.
Color-index, 1.
Erythrocytes per c.mm., 3,030,000.
Leucocytes per c.mm., 16,800.
Polymorphonuclears, 66 per cent.
Lymphocytes, 20 per cent.
Large mononuclears, 11 per cent.
Eosinophils, 3 per cent.
Poikilocytosis, not marked.
Nucleation, none.
Size, some irregularity.
Polychromatophilia, present.

Both of these cases are, I believe, true cases of splenic anemia, in the third stage of the disease with the symptom complex of Banti.

Case 3.—M. S., male, aged 47, Russian. Occupation, motorman.

Admitted December 30, 1915. Complaint, pain in the abdomen, headache, loss of appetite, pain in the back and legs.

Six months before entering the hospital, he began to feel drowsy, had headache, poor appetite, pain in the legs and numbness. In about three months, he gave up his work because of weakness, and began to have chills with high temperature, up to 105 degrees, and night-sweats. Patient became jaundiced. October 8, he went to the Crocker Street Hospital, Los Angeles. He was given mercurial inunction and potassium iodide in large doses, and improved, his temperature returning to normal. The trouble recurred in about a month. He was again treated with mercury and potassium iodide, and recovered sufficiently to go to work. The next time he did not improve by the treatment with mercury.

Previous illnesses: measles; denies venereal diseases. Family history, negative; habits, alcohol moderately.

Physical examination: Slight jaundice; heart-sounds, faint systolic murmur over the apex and tricuspid areas; liver extends two finger-breadths below the costal arch; spleen, greatly enlarged; abdomen seems distended and tympanitic.

Stomach examination: test-meal, negative; feces, negative; no blood; Wassermann, negative.

Exploratory operation, January 11, 1916: cultures made from the blood aspirated from the liver and spleen showed no growth; the surface of the liver was smooth; urine, albumin, a trace, a few granular casts.

Blood examination, February 24, 1916:
Erythrocytes per c.mm., 3,360,000.
Leucocytes per c.mm., 9,200.
Polymorphonuclears, 40 per cent.
Small mononuclears, 46 per cent.
Mononuclears, 11 per cent.
Blood examination, September 25, 1916:
Hemoglobin, 50 per cent.
Color-index, 85.
Erythrocytes per c.mm., 2,940,000.
Leucocytes, per c.mm., 22,200.
Polymorphonuclears, 39 per cent.
Large mononuclears, 2 per cent.
Small mononuclears, 59 per cent.
Size, irregular.
Poikilocytosis, well marked.
Macrocytes, present.

Operation, October 5, 1916: splenectomy; 500 c.c. of blood expressed from the spleen after removal was citrated and reintroduced into the patient's veins; he stood the operation well.

Post-operative: patient healed primarily, but ran a high temperature for several days after the operation; he then began to improve, the temperature returning to normal, and he remained better for a week or two, when he had a relapse with high temperature and loss of appetite and weakness. These relapses have occurred periodically up to the present time. Following attacks of fever, the patient will have diarrhea for a day or two, and the temperature returns to normal.

Blood examination, October 24, 1916, three weeks after operation:

Hemoglobin, 60 per cent.
Leucocytes per c.mm., 33,000.
Blood examination, November 10, 1916, five weeks after operation:
Hemoglobin, 60 per cent.
Erythrocytes per c.mm., 3,160,000.
Leucocytes per c.mm., 33,700.
Polymorphonuclears, 14 per cent.
Large mononuclears, 42 per cent.
Small mononuclears, 35 per cent.
Eosinophils, 1 per cent.

Case 3 was variously diagnosed as Hanot's cirrhosis, chronic leukemia, splenic anemia, and pyroplasmosis. The presence of a large spleen, and a secondary anemia, with slight jaundice and a leucopenia, except during a period of fever, justifies the diagnosis of splenic anemia. Recent urinalysis and functional kidney tests show very poor elimination and a marked albuminuria. Phthalein failed to appear in the urine of the left ureter at the end of thirty minutes. It appeared in the catheterized specimen from the right side in ten minutes. The total output in thirty minutes was only, 7.5 per cent. This failure of kidney-function at times approaches complete suppression, accompanied by high fever and diarrhea. It is characteristic of the second stage of splenic anemia.

Blood count, November 23, 1916:
Erythrocytes, 3,430,000.
Leucocytes, 42,500.

PATHOLOGIST'S REPORT

Spleen after fixation in formalin measures 24x8x12 cm., and weighs 13.63 gms. Capsule is smooth and thin. Cut surface is of a slaty pigmentation.

Microscopic: There is a moderate diffuse increase in connective tissue. Very striking is the enlargement of the venous sinuses. These are filled with large mononuclear cells, apparently endothelial. Throughout the tissue are small granules of brownish pigment most abundant in the endothelial cells. In the central portions of the lymph-nodules and in the walls of some of the blood-vessels is a small amount of homogeneous material resembling amyloid (specific tests not made).

The endothelial proliferation in the sinuses gives a picture resembling that of the Gaucher type of splenomegaly.

November 30, 1916.

—R. W. Hammack.

I have collected 38 cases from the literature, which with 3 cases of my own make 41 in all. Of this number, 6 died as a result of operation, making an operative mortality of 14.5 per cent. The operative mortality prior to 1908 in 61 cases was 19.5 per cent. No doubt there have been many cases which have not been reported, and there are many more in foreign journals which I have been unable to secure, but the cases herewith reported are representative of the surgical results in this disease.

Operation done in the first stage of the disease is curative in a large percentage of cases and the operative mortality is no higher than in other major abdominal operations. In the second and third stages of the disease, there is still a large percentage of recoveries with great improvement of health. Our views regarding splenic anemia will, no doubt, change from time to time as our knowledge regarding the normal physiology and the pathologic changes in the spleen becomes more exact. Our experience thus far in splenectomy for Banti's disease would seem to justify the conclusion that over-functioning of the spleen, whether of toxic or bacterial origin, is the cause of the anemia and the liver changes so characteristic of the disease.

The most striking lesson taught by my cases was the great distensibility of the spleen, and the importance of saving to the patient, either by preliminary ligation or by autotransfusion, the large amount of blood contained in the organ.

DISCUSSION

Dr. Donald Balfour (Rochester, Minn.): I have been much interested in this paper, and especially in the suggestion of the reintroduction of the blood obtained from the spleen after its removal. Theoretically, this may be of some importance. As to its practical value, I am not so sure, and I would like to know Dr. Lockwood's opinion in closing, as

to whether the same result can be obtained by the preliminary ligation of the splenic artery and by careful manipulation of the spleen for a half a minute or a minute to empty it of its contained blood through the unclamped veins. I have done this on several occasions, but I doubt whether it is of any value.

Transfusion has become one of the most valuable surgical measures, and, although its most striking value is in cases of sudden hemorrhage, it is recognized as of great importance in various types of anemia. In pernicious anemia, patients can be carried through critical crises by repeated transfusions of small quantities of blood, and their condition can be greatly improved in various other anemias associated with splenomegaly. We have, therefore, adopted as a routine the practice of procuring for a patient with splenic anemia, for instance, a suitable donor, not only to get the patient in proper condition for operation, but to have the donor available for emergencies, because experience has shown that one cannot anticipate the difficulties of splenectomy. In many instances, the operation is easy, and the adhesions are not great. The next case may seem to be the same, and yet, after separating the adhesions along the anterior border and dividing the gastrosplenic omentum, large concealed veins may be ruptured in the dislocation of the spleen, causing serious loss of blood. We have followed the spirit of preparedness, and have had a donor available for such emergencies as that, or for emergencies which may occur during the convalescence of the patient.

There are many problems in splenectomy which are unsettled. Dr. Lockwood has referred to the difficulty in diagnosis. Many spleens have been removed on the assumption that the disease was splenic anemia, when it was in reality an atypical leukemia or pernicious anemia, or some of the various infections which are associated with splenomegaly and anemia. But there is one striking fact, and that is the specific effect of splenectomy in splenic anemia in the early stage of the disease. In the late stage the desired result is rendered less certain by the development of hepatic cirrhosis. It might be suggested that when splenectomy is done for a splenic anemia, and perhaps in all diseases of the spleen, if possible, one should excise a small section out of the liver for microscopic diagnosis and for a record as to the condition of the liver in that particular case.

The diagnosis is difficult, not only clinically, but even at the operating-table it is sometimes impossible to say what the case is or where it should be grouped. I recently operated on a boy, 9 years of age, who came with a very large spleen. His blood-count was low, but there was little secondary anemia. We could not classify the case clinically, but put it down as atypical splenic anemia. I removed the spleen, and found a marked cirrhosis of the liver. We did not know whether to class this case as a primary cirrhosis of the liver or primary splenomegaly with secondary cirrhosis.

I think Dr. Lockwood has brought out some very important points, and we are greatly indebted to him for adding these three interesting cases to the literature on splenic anemia.

Dr. W. R. Cubbins (Chicago): An Italian woman was referred to my surgical service at the Cook County Hospital a year ago. She presented the clinical picture of a case of secondary anemia, with a low hemoglobin, and was probably in what is called the first stage. In this case we made no attempt to return the blood from the spleen at all; we simply brought the spleen out, ligated the pedicle, and returned the pedicle to the cavity after covering it over fairly well. She showed no symptoms of any kind afterward. It was the simplest kind of laparotomy, with recovery. Her blood-picture never went afterward above 11,000.

The question arises in my mind, do we really want the blood in the spleen? If it is the seat of disease, would it not be better to take out the spleen with the blood content and avoid a certain degree of infection which might be latent there, but of which we do not know the exact character at the present time.

Dr. B. B. Davis (Omaha): I am very much interested in this paper of Dr. Lockwood's, and have been very much interested in the subject for a good many years.

To begin with, it seems to me, the whole subject of the splenomegalies has given rise to more or less confusion; in fact, our general classification is very much different from what it was a few years ago. It was not very long ago when it seemed to be a difficult thing to determine whether the spleen was a fit subject for removal or whether it ought to be left alone. We now feel it is an absolutely fixed point that the enlarged spleen in a myelogenous leukemia should be left alone, and also the enlarged spleen that we get with very

many of the infections, it is better to leave it alone. So in the diagnosis it simply resolves itself into a combination of the clinical symptoms and blood-picture.

I had a case that came to me a few days ago where I thought we certainly had the first stage probably of Banti's disease from the fact that the man had an enlarged spleen. He was a young man, about 35 years of age, and was the perfect picture of health. He did not seem to have anything wrong with him; he felt quite strong. The only thing he complained of was that when he did a particularly hard day's work he felt tired. I had an assistant in the hospital make a blood-count, which was the first one made, and to my surprise it showed 450,000 whites. He remained in the hospital a week or two, and during that time 280,000 was the lowest we got. This was a case of myelogenous leukemia. We sent him to his home physician.

In the cases of Banti's disease, it seems to me, an important factor, if possible, is to remove the spleen during the first stage. I do not know of any disease that is more amenable to surgical interference than Banti's disease if an operation is done before the other changes occur. Of course, if it runs on to the third stage, we get hepatic complications, and the final result from splenectomy is not likely to be so good. However, from the very fact that this condition is so amenable to treatment, if the splenectomy is done early, it makes it especially important that in all cases of enlarged spleen they should be worked out as early in their history as possible, so that if it is one of the cases that can be relieved by operation, it should be done at that time.

Dr. J. L. Yates (Milwaukee): It seems in the discussion of a disease so specific as Banti's disease, it is only fair that the disease should be considered according to Banti's own conception of the process. In all of his work this point comes out strongly: It must be primarily a localization of some form of toxin in the spleen, as shown by endophlebitis in the splenic vein and portal vein proximal to the entrance of the splenic vein. In one of his papers, the second one published in Ziegler's *Beiträge,* he makes the specific statement that the type of disease of the spleen which he describes under his name may be merely the splenic manifestations of so-called pseudoleukemia.

We have been deeply interested in this problem and have studied these lesions both bacteriologically and histologically.

In three out of five cases a diphtheroid organism was obtained in pure culture. We attempted to determine what would happen upon the reintroduction of these diphtheroid organisms into the circulation of dogs. Dogs in our part of the country are constantly abnormal so far as the lymphatic system is concerned, so each dog served as his own control. Pieces of the liver and of the spleen were excised, trying not to take out enough to affect the physiological potentialities of the spleen; and from these, cultures and sections were made. This procedure was repeated at intervals after intravenous injections were begun. After the injection of the diphtheroid organisms into the spleen there developed a lesion which is comparable to the lesions that occur spontaneously in the human in Banti's disease. A positive culture was obtained occasionally. Another thing is, these dogs, after injection of the diphtheroid organisms, developed a blood-picture comparable to the blood-picture which developed in the human. As controls, staphylococci, colon bacillus, and bacillus Hoffmann and bacillus pseudodiphtheria were used. The histological picture of the spleen was very different, and the cultures negative.

According to Banti, this whole group of diseases is diagnosible in life by the blood-picture, and by the morbid histology after death or operation. Bunting's work shows that this blood-picture is a slight variation from that occurring early in Hodgkin's disease. After an early removal of the spleen the blood-picture tends to go back, after a time, to normal.

It does not seem to be fair that the other types of splenomegaly or splenic anemia should be classified definitely as Banti's disease unless there is histological and hematological confirmation of that diagnosis.

Dr. M. L. Harris (Chicago): I desire to say a few words relative to the permanency of the cure following splenectomy in these cases. There is very little said in the literature regarding this point, and the reason perhaps is, that most of the cases have been reported too early to say what the end-result is going to be.

Some years ago I presented an article on this same subject in which I included all of the cases up to that date, as well as my own cases; and I am enabled to report one of these cases now, thirteen years after operation. As far as I know, it is the oldest one that has been followed up

and reported. This was one of the cases I reported in that paper.

The patient was a young woman who had all the typical symptoms, and on whom I did splenectomy. The patient lived thirteen years, and when she died she was in apparently perfect health. Her death was sudden, due probably to suicide, so that she did not die from any pathological condition.

It is also interesting to note the change which takes place in the blood, and which in this patient was permanent. The blood did not return to normal at any time, but there persisted a constant eosinophilia of from 15 to 12 per cent. I had many opportunities of examining her blood during these years. In the other cases of splenectomy that I have done for this condition all have developed eosinophilia, which, so far as I know, has persisted.

Dr. Lockwood (closing): I wish to answer briefly the various questions. First, Dr. Balfour spoke about the preservation of the blood, and whether or not by ligaturing the splenic artery and milking out the blood one might not accomplish the same purpose. In my second case, I ligated the splenic artery, and prevented the loss of blood as far as possible; but, in spite of that, 500 c.c. of blood escaped through the spleen after the removal, or about one-half as much as in the first case reported. Some spleens are so deeply situated, and there are so many adhesions, it is entirely impossible to ligate the splenic artery before the spleen is removed, and one will be content if he can grasp the pedicle with the forceps and remove the spleen.

As to the remarks made by Dr. Cubbins: The blood recovered from the spleen after removal might be infectious, but we have little proof of this. We made repeated cultures from blood of these patients, and none of them at any time showed growth in the culture. In one of them, cultures were made both from the spleen and the liver. The blood examined before operation in no way differed from secondary anemia occurring in any other condition such as carcinoma or any of the chronic infections, so that the criticism made would not hold. Certainly, the procedure was life saving in one of my cases.

We are not so fortunately situated in the average hospital as they are at the Mayo Clinic, where things are so well organized and where suitable donors are always at hand. In

our county institutions among poor patients, it is often impossible to get suitable donors, and I believe in emergencies the procedure of autotransfusion will prove of definite and positive value in saving the lives of these patients.

I believe the name, "Banti's Disease," is a poor one, and in studying the subject in preparation of my paper, I felt that I should have changed my title, and used the term *splenic anemia.* Banti's disease corresponds to the third stage which we recognize in splenic anemia.

I read Dr. Yates' paper, and it is certainly very suggestive; however, his findings have not been corroborated by others, and I was unable to find any other evidence that the disease could be ascribed to infection. In fact, all agree that it is probably the result of a chronic toxemia due to infection in some other organ of the body.

INTRACANALICULAR PAPILLOMA OF THE BREAST

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The characteristic feature of intracanalicular papilloma of the breast is a bloody discharge from the nipple. Often this is the only symptom; the tumor cannot be palpated, and may even be difficult to locate when the breast is sectioned. Greenough and Simmons[1] state that papillary cystadenoma, villous papilloma, or duct cancer in which gross intracystic papillary growths occur, accompanied often by a bloody discharge from the nipple, should be considered as true local tumor-formations, which have a very high predisposition to carcinoma. Lewis[2] states that the pathologic processes associated with the discharge of hemorrhagic or serohemorrhagic material from the nipple, should be classified in two groups: Group I, abnormal involution associated with serohemorrhagic discharge; and Group II, small papillomas within the milk duct deep within the breast tissue, no tumor being palpable.

Intracanalicular papilloma may be located at any point in the milk ducts. In one of our cases, a tumor with a long pedicle had prolapsed from the nipple and gave the impression of a papilloma, although careful examination showed that it was not attached to the nipple. Such tumors are usually painless, and have no skin attachment. They have been reported as occur-

ring between the ages of 19 and 81, although I think they are more common past middle life. Trauma and child-bearing are not factors in producing them. In very few of our cases of true intracanalicular papilloma have we been able to distinguish a tumor or palpable thickness in the breast. However, Erdmann[3] states that at times the condition is so well marked as to be readily recognized as a tumor, and for this reason an erroneous diagnosis of simple cystadenoma may be easily made.

The discharge varies in amount, and may be intermittent. Usually, it is slight and comes in drops, although a considerable quantity can frequently be forced out by pressure on the breast. The fluid is odorless, sticky, and stains the dressing a pale-yellow. A discharge accompanying a carcinomatous condition of the breast is more watery, darker in color, greater in amount, and often has a distinct, rather foul odor. The discharge due to papilloma often contains epithelial cells from the milk ducts. Erdmann mentioned one case in which many streptococci were found in the fluid. The thick, colorless discharge associated with chronic mastitis often contains degenerated cells.

The papillary outgrowths arise from the wall of the milk duct. They have a branching, vascular connective-tissue stalk supporting a large growth of epithelium in the form of villous projections and gland-like interlacing tubules. The epithelium does not infiltrate the surrounding tissue. If a tumor is present, it will be found in the central part of the breast, usually just under the nipple. These papillomas may be multiple, and there may be many tumors in the breast. The epithelial layers of the tumor may be composed of a single layer of columnar cells or several layers of cuboidal cells. In papillary cystadenoma we do not know whether the papillary outgrowth is a process

secondary to the formation of the cyst. It would seem that intracanalicular papillomas and papillary cystadenomas were separate processes. Certainly, the symptoms from an intracanalicular papilloma may exist for many years, and yet there may be only the single papilloma in the duct and no evidence of cyst formation except perhaps a slight dilatation of the duct. The only difference between intracanalicular papilloma and papillary cystadenoma would seem to be in the place of origin. Intracanalicular papillomas arise from the walls of the milk ducts, while papillary cystadenomas originate in the walls of the acini. Intracanalicular papillomas are more frequently found as single growths on a pedicle, while a cystadenoma is usually composed of a number of interlacing papillomas. Papillary cystadenomas often attain considerable size and form a palpable tumor-mass or frequently multiple tumors.

Bleeding from the nipple was at one time considered almost pathognomonic of cancer, and many radical operations have been performed on that basis alone. The more recent teachings of Bloodgood,[4] Lewis, and others would seem to show that bleeding is more apt to be a symptom of a benign condition than of malignancy. Bloodgood states that bleeding from the nipple without the presence of a palpable tumor of the breast is not an indication for operation. He reports that he has had under observation for some time 12 cases of bleeding nipple which he considers are intracanalicular papillomas because there is no tumor-mass. These patients have had no treatment, and with most of them the discharge ceased at the end of a few years; however, in one case on record, the discharge continued for twelve years. In 1 case reported by Lewis, malignant changes were found in what was primarily an intracanalicular papilloma. This is the only case I have

been able to find record of in which these changes have been observed. The patient had a bloody discharge from the nipple for three months. Lewis states that a diagnosis of malignancy could not be made from the nature of the tumor or the character of the discharge as the lesion did not differ in these respects from a papillary cystadenoma. The granular wall of the cyst, however, aroused suspicion, and was shown to be malignant. Erdmann reports 2 cases in his series which from gross appearances he thought were malignant, but his pathologist reported that they were benign. The pathologist, however, made a notation that there was an atypical proliferation of the epithelium and that they were suspicious. Greenough and Simmons report 3 malignant cases in a series of 20 cystadenomas.

I have recently reviewed 100 consecutive cases of discharging nipples. I found 50 in which a serohemorrhagic discharge was present, and 50 which had other forms of discharge from the nipple.

In the first group of 50, I found the following pathologic conditions associated with bleeding nipple: 27 patients (54 per cent) had carcinoma of the breast; 12 (24 per cent) had chronic cystic mastitis; 8 (16 per cent) had intracanalicular papilloma. In 3 cases (6 per cent) the early discharge seemed to be a serohemorrhagic oozing from the nipple, which later proved to be Paget's disease.

In the second group of 50 cases which includes those in which there were various kinds of discharges, exclusive of the hemorrhagic type, I found 30 (60 per cent) to be breast carcinomas; 14 (28 per cent) chronic cystic mastitis; 4 (8 per cent) intracanalicular papillomas; and 2 cases (4 per cent) proved to be simple cysts.

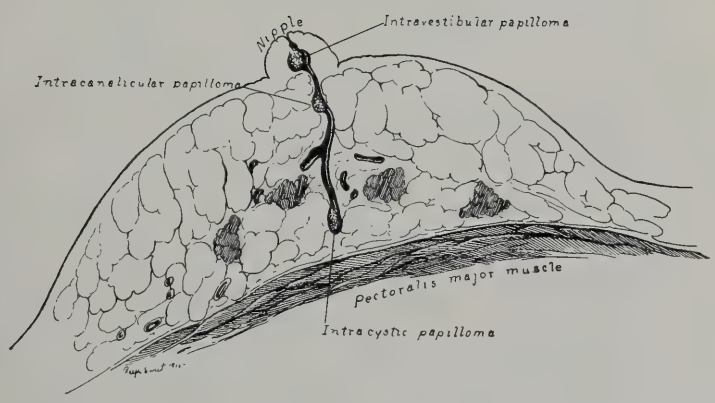

Fig. 1. Diagram of breast, showing different placements of papillomas

Fig. 2. Breast enlarged four times.
a. Intravesicular papilloma.
b. Intracanalicular papilloma.
c. Intracystic papilloma.
d, d, d, d. Pedicles

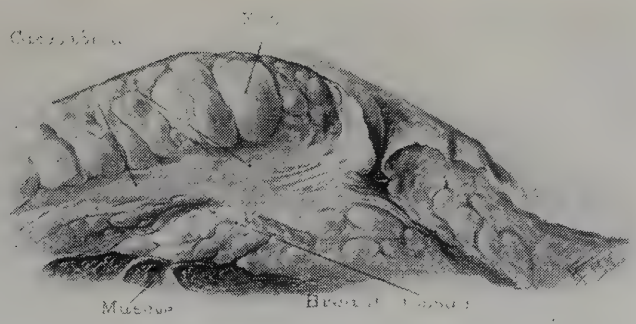

Fig. 3. Carcinoma near the base of the nipple, showing nipple-retraction.

Fig. 4. Extruded papilloma of the nipple.

Fig. 5. Cross section of extruded papilloma of the nipple.

	50 cases serohemorrhagic discharge from the nipple		50 cases other forms of discharge from the nipple	
	Cases	Per cent	Cases	Per cent
Carcinoma	27	54	30	60
Chronic cystic mastitis	12	24	14	28
Intracanalicular papilloma	8	16	4	8
Paget's disease	3	6	0	0
Simple cyst	0	0	2	4

SYMPTOMATOLOGY

Group I.—Bleeding nipples: A tumor was present in each of the 27 cases of carcinoma. The first symptom in 22 of the 27 was a tumor; in the remaining 5 cases it was a discharge from the nipple. Fourteen of the 27 patients complained of pain in the breast. Twenty-three patients out of the 27 had undergone lactations. The average duration of the discharge was ten months; the average age of the patients was 54 years.

A tumor or palpable thickening in the breast was present in 7 of the 12 cases of chronic cystic mastitis. In 9 of the 12, the first symptom was discharge; in 3 it was pain; however, only 4 out of the entire 14 patients complained of pain at any time. Eight of the 12 had undergone lactations. The average duration of the discharge was 10 months; the average age of the patient was 50 years.

A palpable tumor was present in 4 of the 8 cases of intracanalicular papilloma. Nipple discharge was ten months, the average age of the cases. Three of these patients had undergone lactation. The average duration of the discharge was about four years; the average age of the patients 47 years.

In the 3 cases of Paget's disease the early symptom of serohemorrhagic oozing from the nipple was later followed by ulceration and crusting.

Group II.—Non-hemorrhagic cases: A tumor was present in 29 of the 30 cases of carcinoma in this group. In the one instance in which the clinician was

unable to palpate a tumor, the carcinomatous growth was small, involved the area directly beneath the nipple, and could easily have been missed. Tumor was the first symptom noted in 23 of the cases; in the remaining 7 it was discharge. Pain was present in 26 out of the 30 cases. The average duration of the discharge was thirteen months; the average age of the patients 50 years.

A tumor was present in 13 of the 14 cases of mastitis. The case in which a tumor was not palpated was that of a woman who four years previously had had a tumor removed from the breast and whose complaint at the time we examined her was pain and an intermittent glairy mucoid discharge. Tumor was the first symptom in 5 cases; discharge in 4; and pain in 5. Ten of the 14 patients complained of pain. Ten patients had undergone lactation. The average duration of the discharge was 18 months; the average age of the patients 46 years.

A tumor was present in 3 of the 4 cases of intracanalicular papilloma. The first symptom in each of the 4 cases was discharge from the nipple. Pain was present in 1. All of the 4 patients had undergone lactation. The average duration of the discharge was three years; the average age of the patients 52 years. These cases really belong to the hemorrhagic group, as the discharge was variously described as chocolate colored, dirty brown, etc., showing that hemorrhage had taken place in the cysts at some time or other, but had been retained and undergone changes.

A tumor was present in both of the 2 cases of simple cysts. In 1, the first symptom was tumor; in the other, discharge. The discharge was described as milky or yellowish in appearance.

Recently, in reviewing our 32 cases of papillomas of the breast, I found the following pathologic classifica-

tion: intracystic papillomas, 8; intracystic carcinomatous papillomas, 8; intracanalicular papillomas, 10; carcinomatous intracanalicular papillomas, 3; intraacinar papilloma, 1; intracanalicular papilloma associated with a carcinoma of the breast, 2. In this series, carcinoma was present in 11; in 3 other cases, the pathologist believed the condition was carcinomatous, but he was unable to make a definite diagnosis.

The characteristic symptom in these 32 cases was bleeding or a serohemorrhagic discharge from the nipple. In a few instances there were palpable tumors, but in all of these the growth was produced by chronic mastitis or by cystadenoma, and in no instance was there a papilloma in the duct large enough to be palpated, except in one case, in which it extruded from the nipple.

This review of 100 cases of discharging nipples would seem to confirm former reports on the subject. Carcinoma appears to be the most common lesion producing a discharge from the nipple, but it is almost invariably associated with a tumor in the breast. Tumor is usually present some time before the discharge begins. In some of our cases of chronic cystic mastitis, the discharge may have been from a duct papilloma, for often these tumors are very small and might easily be overlooked. This series also seems to lend evidence to the contention that a hemorrhagic or serohemorrhagic discharge from the nipple in the absence of a palpable tumor is most often produced by benign intracanalicular papillomas. In view of this fact, treatment should be conservative, especially in young women. In older women, particularly if the condition is associated with chronic cystic mastitis, the best procedure would seem to be the removal of the mammary gland. If there are evidences of malignant change, a radical operation should be done.

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FOR DISCUSSION SEE PAGE 371

A TECHNIC FOR THE RADICAL CAUTERY OPERATION IN BREAST CANCER

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Following the progressive and improving work of Halsted, of Baltimore, Willy Meyer, of New York, and Kocher, of Berne, Switzerland, the results in the operative treatment of cancer of the breast made a distinct and gratifying advance. But little has been added to the technic of their operative work in this condition except in the way of improved cosmetic appearance of the post-operative scar and ease of operating by the incisions of Jabez N. Jackson, J. Collins Warren, and Francis T. Stewart.

We are probably warranted in believing that in the hands of trained operators 50 per cent of the women who submit to the modern radical breast operation will live over the five-year period, without a recurrence of their carcinoma, provided always that the patient is at all in the operable class. In the remaining 50 per cent the greater number will have recurrences within the first year of the radical removal of the breast. I have seen a rather large number of these recurrences in the last three years. The location of the new invasion has been about equally divided between the site of the operation, including the skin, and the supraclavicular region. The latter space, in the cases seen, had not been invaded by the sur-

geon in his previous operative work. In recent years I have seen no operated cases where metastasis had developed in either the abdomen, the thorax, or the extremities.

A recent post-operative recurrence in breast carcinoma, which came under my observation, was in a woman (Mrs. M.), aged thirty-four. She was born in Greece; was the mother of three children; and had had two miscarriages. When she presented herself for examination, because of a recurrence following removal of a left mammary carcinoma, she was three and a half months pregnant. The history of this breast is interesting from the fact that when twelve years of age she had an abscess, which was incised by her physician. There remained a small lump in the scar, which never disappeared. One and a half years ago this lump began to enlarge and at times was painful. Last June (1916) it had attained the size of a hen's egg, and was removed, by a surgeon in a distant city, by the usual radical operation, including the extirpation of both pectoral muscles. She remained with no evidence of a recurrence for three months, when she began to fail physically, became very anemic, and lost thirty-five pounds in weight. Her hemoglobin at this time was 50 per cent. (Dare.) One month after her operation she noticed in the operative scar a lump the size of an olive. There were also movable masses the size of a hen's egg in the outer quadrant of the right breast, which she had noticed for four years. (Fig. 1.) The axillary glands on this side were also involved, many of the size of marbles being present. The right side had not been operated on,—why? I do not know. The supraclavicular glands on this side were not palpable. The patient was bedridden and a physical wreck. Her left arm was enlarged about one-third. Metastasis was marked both on the operated and the unoperated side, extending along the subclavian and axillary vessels. On the operated side points of recurrence, both in and below the skin, were very numerous. These were noticeable in the scar of the former operation and especially in the auxiliary incisions, which had been made in order to relieve the tension in the stretched flap. There were also recurrences in practically every suture scar. The new growths along the axillary vessels were extensive and fixed, and extended nearly one-third the way down the arm. The

supraclavicular glands were not palpable on this side. The skin in the axilla was adherent to the underlying structures and, on manipulation, gave the examining finger the impression of a bony growth surrounding the axillary vessels, at least three inches long and two inches wide. All the tissues in this region, including the skin, were firmly fixed and immovable. (Fig. 2.)

The patient complained of no pain in the thorax and no cough, and there was no special dyspnea on exertion. The *x*-ray disclosed no metastasis in the lung tissue.

This woman had a pale, pasty look, her eyes were sunken; the leg muscles were greatly atrophied; and with it all she was in the trough of despair. She had recently visited a number of clinics, and from them all had received the usual advice, to go home, take morphine, and die.

From any point of view, to say nothing of its surgical aspects, this case was a most unpromising one. My purpose in reporting it, however, is not to describe the technical difficulties incident to the treatment of a case of this character by the cautery; but, rather, to emphasize, first of all, the ease with which the cold steel knife, in some cases at least, disseminates by auto-infection the cancer cell, or germ, and, second, to describe a technic by the use of the cautery knife which will reduce the danger of the dissemination of this unknown infection to a minimum. A careful view of Fig. 2 easily demonstrates the area of the skin surface and of the axilla involved in the recurrence following so soon after operation on this patient.

Modern surgery has always recognized the necessity of preventing bacterial infection of the operative field. In an indefinite, or, rather, perhaps in a haphazard way, this necessity has been recognized also in the operative surgery of cancer. Autotransplantation infection in cancer is an insistent fact when the ordinary methods for its removal are used, and the only means at our command for its prevention have been

mainly by the advocacy of incisions made wide of the disease; this, always, with the hope, not only of getting all of it, but more to the point, of preventing the knife of the surgeon from coming in contact with a small focus of the disease at an unusually outlying point. The trouble is that the disseminating and stimulating effects of the cold, sharp edge of the surgeon's scalpel have not been recognized acutely enough. This danger, I repeat, has always been known when infective bacteria were the problem in the operative field; but infective bacteria, when managed according to present-day surgical principles, are a simple enigma in comparison to the cancer-cell. Surgery, so far, has not been able to evolve any principle, or principles, that either modifies or prevents the slow but certain progressive development in the tissues of the cancer-cell except the one just mentioned, of wide excision. Bacterial infections are usually surface infections. They can be washed and poisoned away. The infections of cancer are not surface infections. They cannot be washed or antisepticized, because they are in the tissues and skin, not outside of them. Modern surgery has not yet recognized this fundamental difference in a practical way. Present-day surgery still exposes and spreads cancer along newly-made tissue surfaces, and stimulates it into new virulence with the cold steel knife, and then carefully sews in and covers up with flaps the infection of cancer where it can spring again into new life, uncontrolled and unhindered. In this way we ignore every known surgical principle for the prevention of cancer infection. When the flaps are sewed together, we have a hope that nothing is left in them or in the wound, and we keep on hoping for five years that the infection will not show up.

The prevention of the auto-dissemination of cancer during its removal is the greatest problem in the operative treatment of the disease today. This is especially true in the so-called inoperable types of advanced carcinoma, regardless of its location. In offering the cautery knife as a valuable substitute for the cold steel knife, I do so because it disseminates heat, and heat kills the infecting principle, whatever it may be, of cancer. The cautery will destroy the infecting agent with every step of the dissection, not only at the immediate point of contact, but at a considerable distance beyond. This is true of the cut edges of the tissues, of the flaps, and of the deeper structures, as well. They are left, not only sterile, but immune to the further development of the cancer growth. It should also be emphasized that all tissues involved in cancer should be manipulated in the most gentle way possible, both before and during operative procedures. I am convinced that to ignore this means a greatly increased possibility of disseminating the disease into new regions.

It will probably be of interest and value to state here that I have seen no untoward results from the use of the heat, even when large areas of the thorax, axilla and the neck were denuded of their coverings by the heat technic that I shall outline below.

The only possible exception to this is Mrs. F. M., aged 42, who was suffering from a very extensively infected and ulcerating right mammary cancer which she first recognized some four years previously. The right arm was also greatly enlarged, painful, and useless. Her chief complaint, however, was from what she called her "rheumatism." This seemed to consist of a generalized myositis. The pain, together with the stench from the ulcerating breast, was what finally drove her to seek surgical relief. The involvement of the axilla, with the extension of the malignancy from the breast, was so great that I decided to do an interscapulo-

thoracic amputation at the shoulder-joint, with the cautery, at the same time that the breast was removed.

The operation was performed December 22, 1914, and required thirty minutes. No clamp was used at any time, except on the subclavian artery and vein. This woman was a bad risk from the beginning, but she was out of bed and in a wheel-chair on the third day, and was having a normal convalescence until the eleventh day, when she developed a chill, rusty sputum, and a pneumonia in the left lung (the one opposite the operative field), and died on the third day, fourteen days following her operation. This result may have been connected in some way with the extensive use of the cautery, but I have never been convinced that it was. This is my only operative fatality.

My only accident from the use of the cautery in the axilla occurred while operating on Mrs. J. P. H., aged 58, who was first examined March 25, 1916. Three years before she had noticed a small lump in the outer edge of the left breast. She had had no previous treatment, and consulted the surgeon only because the breast was ulcerating and painful. At the time of the examination, the breast was fixed to the thorax, and showed both glistening red and blue areas, as well as the ulcer, which was about the size of a silver dollar. The *x*-ray disclosed no involvement of the lung or ribs. Amputation of the breast, and dissection of the axilla with the cautery, was done March 26, 1916. In dissecting the axilla the cautery knife was carelessly allowed to touch the axillary vein for too long a time, and instantly the whole of the exposed vein became thrombosed, as is shown in Fig. 3. The arm increased in size, at least one-third before she left the hospital. In physical appearance it reminded one of the familiar lymphangitis that occasionally follows breast amputations by the ordinary technic. Fig. 4 shows the present condition of this patient, and especially of her arm. The enlargement practically disappeared in six months. The function of the arm at the present writing is in no way interfered with, except by the scar, which resulted from the extensive dissection required at the primary operation. The return of the circulation in the arm can probably be explained by the ease with which the collateral circulation is re-established through the cephalic vein over the top of the shoulder.[1]

1. This patient recently presented herself because of severe pain in the left humerus. An *x*-ray showed a metastatic focus, involving the whole diameter of the humerus at its middle portion, about one and one-half inches in length. The arm was then amputated with the cautery at the shoulder. At the present writing she is in good condition.

The actual technic of the use of the cautery is essentially not unlike the ordinary method with the steel knife. When one becomes familiar with this, the danger is no greater, as far as the axillary dissection is concerned, than with the scalpel. More than this: there is a great satisfaction in knowing that the hot knife is not disseminating carcinoma in its way through the tissues, and, besides, the heat is having an influence for good considerably beyond the area involved in the immediate contact with the cautery knife. In other words, the heat can be made to go safely where the cautery or cold steel knife cannot go. The explanation is that the circulating blood remains at a constant temperature, indeed, acts as a water-cooled speculum, thus protecting the walls of the larger blood-vessels, but not the carcinoma which may be in the tissues about them.

Frequently, intact carcinoma cells can be found about a large blood-vessel. In such cases it it probable that the circulating blood prevented the heat from attaining a temperature sufficiently high to destroy the attached carcinoma cells. The blood-vessel has merely acted as a water-cooled speculum, protecting the carcinoma cells from the destructive action of the heat. No artery clamps should be used to arrest hemorrhage in the small vessels; the application of the heat is sufficient. This not only arrests the hemorrhage, but does more by destroying the possibly present nesting carcinoma cells. It is for this reason also that in these advanced cases, flaps to cover the wound should not be especially striven for. If small points of carcinoma develop in the uncovered wound, they can be trated at any subsequent dressing by applying a little cocaine and touching them with the cautery point until destroyed.

Again, scar tissue of this type seems more likely to remain free from a new growth of malignancy than is the normal tissue. This surface treatment of cancer by heat is thus made much more effective than can ever be true of cavity carcinoma. Carcinoma developing under the made flaps, following a breast amputation, puts it at once in the same class with the insidious type of cavity carcinoma,—that is, the small points of recurrence cannot be recognized early enough for the most effective treatment when covered by the flaps.

Wiping out the axilla with gauze is, I am convinced, a fruitful source of recurrences in removal of the carcinomatous breast. This method of dissection also violates every surgical rule for the prevention and dissemination of infection and should be included with the cold steel knife in its dangerous proclivity to stimulate anew the growth of cancer.

Freedom from hemorrhage is one of the very important advantages of using the cautery knife. It not only shortens the time that would otherwise be taken in clamping and tying bleeding vessels, but, as stated above, it lessens the possibility of a recurrence about the blood-vessels. More than this: The work of Gaylord seems to show that the saving of blood is an important factor in lessening the destruction of the natural immunity that most of these cases undoubtedly possess.

Necrosis of the exposed ribs frequently follows the application of the heat, but I have never seen this necrosis go below the edges of the intercostal muscles, and I have yet to see either a pleurisy or a pneumonia develop, except in the one case mentioned above. Indeed, the majority of these patients are remarkably free from pain, or any other form of uncomfortable

Fig. 1. Movable masses in right breast.

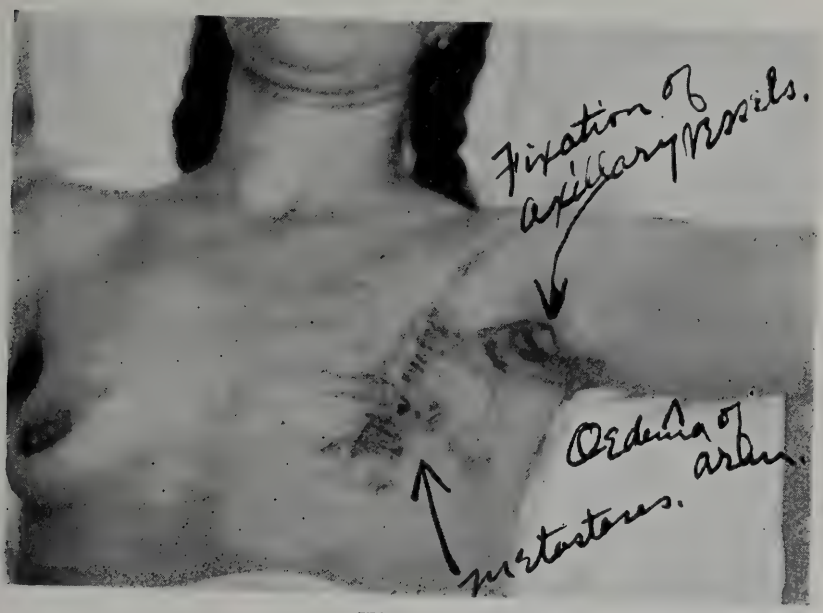

Fig. 2.

Fig. 3. Note enlargement of arm and fore-arm, six weeks after cautery removal of the breast. The wound is granulating and healthy.

Fig. 4. Showing condition of patient, one year after operation.

Fig. 5. The application of small pieces of adhesive plaster, after the method of Beck. This technic limits secretion from the wound, encourages cicatrization, and adds to the comfort of the patient.

Fig. 6. Note the wide grasp of the sutures. This insures a better repair of the cautery incision.

Fig. 7. The outline of the clay-pipe incision to be made with the cautery on the iodine-covered skin.

Fig. 8. The upper cautery shows the incorrect method of getting under the skin. The dimpling incident to pushing the cautery under the skin permits of too much destruction of the skin surface. The lower method, whereby the skin surface is lifted up by a wide-jawed tenaculum forceps, and the cautery pushed under the skin, in the line previously mapped out on the surface, gives a better result in the final healing, because of the irradiated heat.

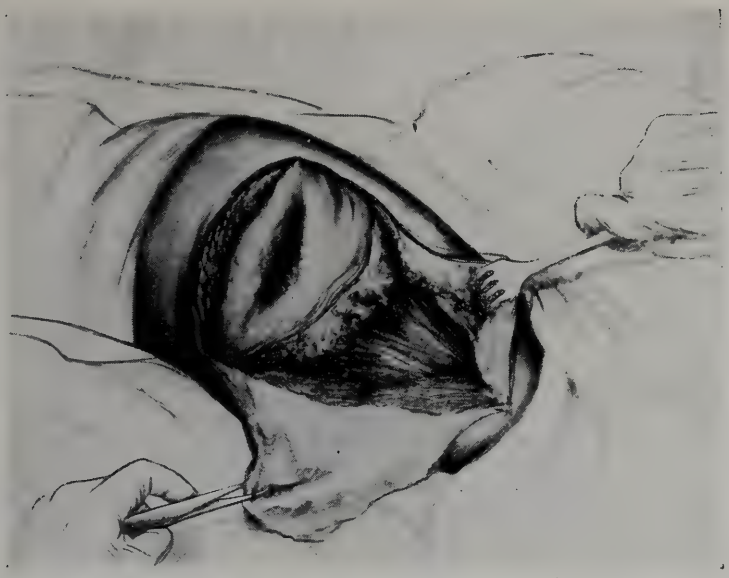

Fig. 9. Cautery dissection of the flaps.

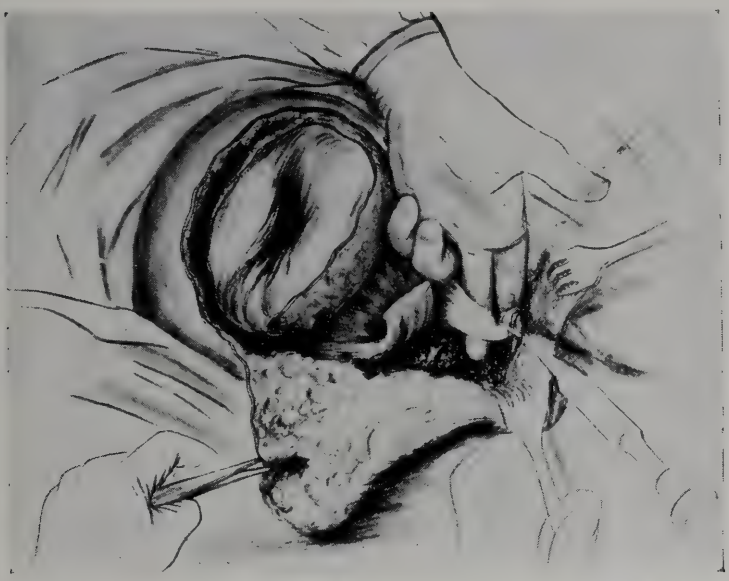

Fig. 10. Opening up of the axilla by severing the tendons of the pectoralis major and minor with the fingers placed back of the tendons. The cautery is shown too near the cut edge of the skin.

Fig. 11. It is better to hold the gland-bearing fascia with the fingers in place of the dissecting forceps and keep them nearer the cautery knife than is shown in the illustration. This will enable the operator to gauge the degree of heat that is being spilled over the vessels and tissues.

Fig. 12. Removal of the gland-bearing fascia with the cautery. The fascia should be held with the fingers, as stated under Fig. 11, and close to the cautery. This is especially true when cleaning off the axillary vessels.

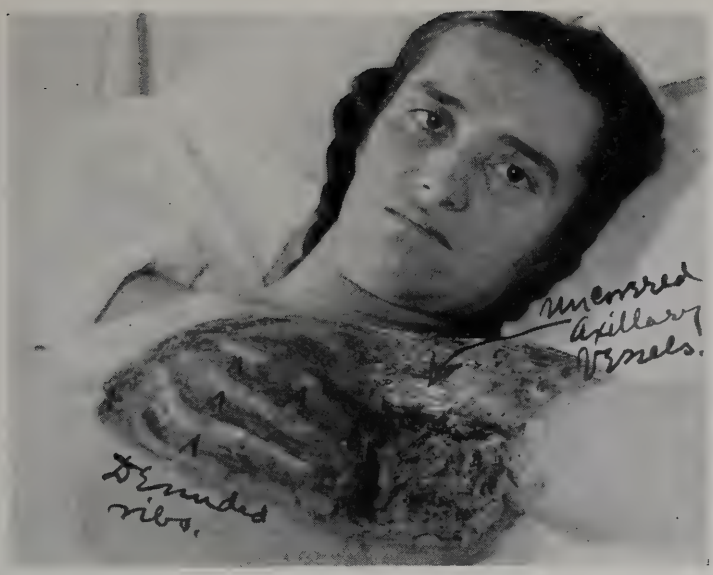

Fig. 13. The condition of the patient and the character of the wound fifteen days after the operation are well shown.

Fig. 14. Appearance of the wound forty-nine days after the cautery dissection. The axillary vessels are well covered in by healthy granulations, and this is true of the whole wound area. This patient died suddenly the day following the date of this photograph. There was extensive metastasis into the left hip and throughout the whole bony structure of the pelvis. The operated breast area was free from cancer.

post-operative experiences. Cooked flesh tells no tales.

The post-operative treatment is dependent upon whether flaps are used or not. In the very advanced cases in which no attempt is made to obtain flaps, the surface is immediately covered with adhesive plaster, after the method of Beck. (Fig. 5.) Where flaps are used to cover the wound, all or in part, they can be undermined or dissected up by the cautery in exactly the same way that is done where the steel knife is used. Sloughing of the flaps is rare, except occasionally at the points. In a few cases (two) where the tension on these flaps has been more than moderate, an active inflammatory condition developed that almost suggested an erysipelas. Both of these were in very fat women. Relieving the tension by removing some of the sutures, and the application of a solution of boracic acid and alcohol improved the condition, usually within twenty-four hours. It is very probable that some of the newer antiseptic solutions that have come into use as a result of the European War would find a useful place in cleaning up these uncovered cautery breast wounds.[2] Where the flaps are employed, usually one drainage opening is sufficient. In closing the wound, it is important to put the sutures about three-fourths of an inch back in sound tissue and away from the coagulated edges of the wound. (Fig. 6.) This insures the sutures holding. If one wants flaps, they can be obtained nearer the gross mass of cancer than would be wise with the knife, for the reason that the heat almost insures against the further development of the cancer-cell in

2. Since writing the above, I have found that one of the most valuable of these solutions is "eusol." It consists of 12.5 gm. each of acid boracic and chlorinated lime in one liter of water. Shake, and let it stand for three hours and filter.

the flaps. The temperature of the knife should not be so great as to encourage very rapid cutting. To do this prevents the abnormal tissue cells from coming in contact with, or being destructively influenced by, the coagulating degrees of temperature which experience has shown are most useful for this purpose.

The four factors most useful in the heat technic are as follows: First, mark out on the iodine-covered skin, with the cautery knife, the limits of the incision to be made (Fig. 7); second, do not cut with the cautery knife from above downward into the skin in following this line, but from within outward. This can best be done by lifting the skin up with a tenaculum forceps (Fig. 8), and pushing the hot knife into and under the skin, and cutting from within outward. To do otherwise causes too great a sloughing of the edges of the skin. The drainage hole should also be made by pushing the cautery knife through the skin from within outward; third, and very important, in dissecting about the axillary vessels and brachial plexus, hold the tissues that are to be removed with the fingers of the free hand encased in a medium-weight rubber glove, and keep the fingers close to the cautery knife. (Fig. 9.) This is the most practical way of gauging the degree of temperature that the tissues and blood-vessels will stand, without being injured. If the axillary vein or artery is not actually touched for too long a time with the hot knife, they will remain uninjured. Fourth, apply the heat until all the tissues that were fixed by the disease are freely movable. To do otherwise simply means that heat dissemination in the most effective way has not been obtained.

The two most important factors in the after-treatment are: First, to keep the wound clean, which can easily be done by alternating the use of adhesive-plas-

ter covering with the "eusol" solution, and exposure to the direct rays of the sun; and, second, to keep the arm in a vertical position alongside of the head. This prevents both edema and cicatricial contraction.

DISCUSSION OF THE TWO PRECEDING PAPERS

Dr. E. S. Judd (Rochester, Minn.): When I first thought of using the cautery in operating on malignant disease of the breast, I had an idea it would probably be a difficult procedure. Cutting the skin, thoroughly dissecting the superficial tissues, cutting the muscles, and freeing the growth from the chest-wall, is done without using hemostats, and is practically a bloodless procedure. The axillary dissection may be done partly with gauze, getting all fascia together with gauze, clamping or holding the vessels, and cutting the axillary branches off with the cautery.

As to the immediate results: I think we have done about fifty of these operations. We began doing them several years ago. While we are not quite so fond of the cautery now as we have been, I will say that the immediate results of cautery operations are very good. The patients are more comfortable than those operated on by a cutting operation. I have never seen any accidents during the operation, such as injuries to the larger vessels or nerves; and in these respects, at least, the operation is all that can be desired, or expected. The healing of the wound is not so good with the cautery as with the cutting operation, although eventually the scar will be practically the same. The functional result is equally good, but the convalescence is longer; often there may be infection. I have had several cases in which the superficial structures were apparently infected, and it seemed as though erysipelas had started. The patients ran a temperature for some time, and were quite sick. This does not occur with the cutting operation as frequently as with the cautery.

Dr. Percy deserves great credit for his work on these inoperable cases. I have been doing the cautery operation less often of late because three years ago some of my early patients came back with local recurrences. It seemed to me that local recurrences were more prevalent in the cases in which I used the cautery. However, the cases were not carefully studied.

Dr. E. P. Quain (Bismarck, N. D.): I would like to ask Dr. Percy in what cases of cancer of the breast he would advocate this treatment, whether in all cases or only in those late ones which we usually call inoperable?

Dr. Percy (closing): I am glad to have my paper discussed by Dr. Judd, because he has had experience along this line. The only thing I did not mention in my paper, which I think ought to have been mentioned, is the point with reference to gauze dissection, which I think is a mistake. Gauze dissection violates all principles of preventing infection. If you get into a carcinomatous nest near the axillary vessels, and infect your gauze and keep on dissecting with it, you are certain to disseminate the infection. If the wound is left wide open in the very advanced case, I think these small points of recurrence can be easily retouched with the cautery. In carcinomatous skin infections, when they recur, we go after them with the x-ray, the cautery, or whatever method we employ, because they are on the surface, and we ought to have these wounds wide open in order to do exactly the same thing in breast carcinoma. I think that this is the explanation of what Dr. Judd has suggested in connection with the possibility of recurrences being a little more common following the use of the cautery than with the knife,—namely, the flaps cover up our infections.

Another important point, I believe, which will prevent these recurrences, is to stop the hemorrhage with the cautery. Cancer occurs most frequently about blood-vessels. I think that men who have not followed this operation will be afraid of doing something to the pleura or the lung, but, so far, I have seen nothing that warranted this fear.

Dr. Quain asked whether we used this method only in the inoperable cases, and, in answer to that, I will say, if the cautery is worth anything in carcinoma, and if carcinoma will spread from the cold steel knife, as was well illustrated in the first picture I showed, then there is no answer to that question except the one of using the cautery in the very beginning.

SURGICAL METHODS IN THE TREATMENT OF MALIGN AFFECTIONS OF SUPERFICIAL LYMPHATIC TISSUE

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A malign affection of lymphatic tissue may be regarded as an inflammatory or neoplastic process which provokes in an individual no sustained tendency to local recovery, and possesses the power of ultimate extension, by whatever means, to increasingly more widespread involvement of this tissue, leading thereby, directly or indirectly, to death. Such affections may originate in lymph-glands, or, having begun in other tissues, may show in their manner of extension a predilection for the lymphadenoid tissue. It is conceivable that, primarily, all are reactions to some form of irritation, and are focal in origin.

The degree of preponderance of the destructive potentiality of any given morbid process over the power of local and general resistance of the individual determines its relative malignancy. Accordingly tuberculous lymphadenitis would be considered a slightly malign affection in a minority of individuals, and carcinomatous involvement of lymph-glands a very malign process in a great majority, whereas the entire group of closely related disease,—leukemia, aleukemic (aleukocythemic) leukemia, chloroma, lymphosarcoma, primary endothelioma of lymph-glands, malignant

lymphoma, Hodgkin's disease, etc.,—has hitherto been accepted as hopelessly malignant.

As a result of the attention that has been given to the problems of tuberculosis, tuberculous lymphadenitis has not alone decreased in frequency, but has also come to be considered so benign an affection that its possible menace to life is now, as Dowd's work indicates (Dowd, C. N.: Jour. Am. Med. Assn., 1916, lxvii, 499-504), dangerously underestimated. The cure of cancer, proclaimed an impossibility by only the last generation, has not alone been established for virtually all tissues primarily affected, but the proportion of recoveries is steadily increasing. Permanent recoveries are recorded in individuals who had suffered from Hodgkin's disease (Yates and Bunting: Jour. Am. Med. Assn., 1917, lxviii, 747-751).

This progress has come, in part, through practical appreciation of the manner of inception and the modes of advance of disease, and, in part, through a combination of the operative procedures thus found to be indicated with such measures in post-operative treatment as lead to an increase in local and general resistance. For example, it has been demonstrated that the removal of all accessible tissue affected in tuberculosis is not essential to a permanent clinical recovery in every case, though some individuals will so recover only after a major portion of this tissue, together with the primary focus, has been extirpated, even if the best of general treatment has been provided from the onset of this disability. Similar observations have been made in the treatment of Hodgkin's disease. Likewise a carcinomatous mass may disappear spontaneously and permanently, though the disease persist or extend elsewhere; or an individual may make a permanent recovery following an incomplete excision of a cancer.

It is difficult to explain such phenomena upon any other basis than that of immunity, hence the significance of the factors entering into the constitution of local and general resistance.

The work of Bunting (Bunting: Bull. Johns Hopkins Hosp., 1917, xxviii, 151-153), of Jas. B. Murphy (Murphy and Morton: Jour. Exp. Med., 1915, xxii, p. 204-211), and of Theobald Smith (Smith, T.: Jour. Med. Research, 1915, xxxii, 455-469) indicates that the functional integrity of the lymphatic system is one factor of fundamental importance in the defense against these malign processes. On the contrary, Tyzzer's (Tyzzer, E. E.: J. Can. Res., 1916, i, 125-156) careful observations upon the modes of invasion of an unusually malignant transferable mouse cancer have convinced him that in carcinoma the lymphatic, more particularly the lymphocytic, reaction is less significant. It is perhaps fair to state in this connection that in the presence of extreme malignancy a very limited reaction of this type is to be expected hypothetically.

Experience, gained in a prolonged study of all these diseases, has led me to a conviction that an accurate interpretation of the leucocytic formula, with due consideration of all other evidence, is at present the most reliable and delicate indicator of the state of general resistance and of the immediate and remote effects of treatment upon it. Comparative histological studies of tissues obtained at operations during different stages of a disease in the same individual, as well as of that excised from other patients of differing ages and various stages and types of the same affection, justify the following tentative assumption: Local resistance varies directly with the ability of the irritated tissue to react with the least abnormal regenerative variations. These consist in an intensive round-cell infiltration, succeeding a constant neutro-

philic and more variable eosinophilic accumulation, and preceding a fibroblastic proliferation, which is accompanied by the development of few or no abnormal-cell (for example, giant) forms or cell- (for example, sarcomatous, endotheliomatous) growths.

NOTE.—Sarcomatous metamorphosis of the connective-tissue framework in carcinoma has been seen to occur spontaneously in human cancer, and has been produced experimentally by Ehrlich. Comparable transformations have been noted in Hodgkin's disease by numerous observers, and I have recognized at least one example of a similar change in tuberculous lymphadenitis.

This assumption holds true in spite of the fact that no power of specific tissue-regeneration is more important, or its impairment more easily recognized, than the hematopoietic, because in these chronic diseases the variations in histogenetic powers appear gradually, and there usually are differences between those of diverse tissues, or even in the same tissues in several parts of the body. In exceptional instances an individual apparently in fair condition may prove to be incapable of making fibrin adequate to primary healing, or quite the contrary may be the fact. A possible explanation of such perplexing observations is the considerable fluctuation in the reserve powers of local and general resistance, which repeatedly approach the vanishing point after the early stage in these types of disease. This would explain the difficulty in forming therapeutic judgment, a matter of prognosis, dependent, as it is, entirely upon these indeterminate factors and their unknown interrelationship.

Divers as are the diseases here considered, we believe that they exhibit in their methods of attack, and in the protective reactions they provoke, such con-

stant phenomena, common in some degree to them all, that therapeutic principles established for one find rather general applicability. The type of surgical intervention to be advanced as essential is based upon the interpretation of the pathology of malign affections given above and upon the following conception of common features in morbid physiology. The powers of resistance of the individual, usually after an initial rise, decrease progressively though irregularly. If the process be unchecked, sooner or later a material diminution in resistance, prone to be sudden, is manifested clinically by an acute intensification of symptoms and often by a proportionately rapid dissemination of the disease. A progressive anemia, secondary in type, is constant; cachexia is common in the more chronic forms, and all, excepting possibly uncomplicated cancer, are febrile at some stage of their progress. Indeed the clinical pictures exhibited by some individuals suffering from these diseases may be so similar that a positive diagnosis is possible only through a histological study of the lesion by a competent pathologist. Generally the extent of the disease revealed at operation or autopsy exceeds that recognized at previous examinations. Quite as constantly, but to an even greater extent, the reserve powers of resistance and regeneration are less than can be estimated by any clinical methods now available.

Rational treatment is an exact play upon the powers of local and general individual resistance against the ineradicable portion of the morbid process. This method of attack must be based upon an accurate knowledge of the factors leading to therapeutic failure rather than upon a general conception of empirical methods reputed to have preceded fancied or occasional recoveries, not accepting any less accurate

philosophy of treatment, even though successful in a high percentage of reported cases. Subject to individual variations the clinical applications of the therapeutic measures leading toward recovery are easily stated: first, the primary focus or portal of entry of the disease must be eliminated; second, a subtraction from the total amount of disease adequate to place the balance of power emphatically upon the side of individual resistance must be so accomplished as not to decrease general resistance, yet to increase local resistance by the prevention of local recrudescences; third, the subsequent play upon the powers of general and local resistance must be continued long after all evidence of the disease has disappeared.

Surgical methods are subject to so great variation in application that they are more presentable in principle than in technical detail. Extreme examples will show the limits of these variations.

The earlier and the more favorable the disease the more radical should be the extirpation. It is always safer to assume that the disease is more than apparent, of greater dissemination than demonstrable, and that individual resistance has been diminished dangerously. Thus only can a patient suffering from a potentially lethal disease be given every chance of recovery with minimal danger at a time when, if ever, prognosis should be good. The usual hypothetical objections to this statement can be answered by the results of clinical experience.

Mortality from radical operations undertaken at an early stage of disease should be no greater than after incomplete interventions. Wound-healing is as rapid and as favorable, and convalescence, therefore, not more protracted. Functional results are similar since, with one possible exception, every essential vessel, nerve, and muscle can be preserved. Even the cos-

metic results, negligible as they are under such conditions, may be made but little more unsatisfactory. The inherited superstition that lymph-glands thus eradicated do not regenerate is contrary to fact. Such regeneration is in adults a matter of a few months, and, if not subject to prompt re-involvement, this recently developed lymphadenoid tissue is locally hyper-resistant and contributes to increased general resistance as well. In the presence of early recrudescence, just the reverse is true. This is the irrefutable pro-radical argument.

The other limit is presented in patients incurably affected in whom, for whatever reason, palliation is indicated. These individuals have lost their regenerative capabilities to such an extent that the problem is now to obtain a sufficiently protracted local relief to insure physical and psychic amelioration for the remaining period of life. Extremely radical dissections are occasionally contra-indicated. A decision as to what to attempt under such conditions, is extremely difficult because of the impossibility of estimating the reserve power of resistance. In spite of the higher operative mortality in this group of patients, intervention is justified since proper judgment as to treatment may gain a respite of months, even years, of hopeful life.

Between these extremes there is so large a range of therapeutic possibilities that indications for the application of surgical procedures to the neck, axilla, and groin must be restricted to an outline of the more dangerous groups of glands and an indication of satisfactory methods of extirpating them. The distribution of lymph-glands and groups of glands that have been found to be subject to involvement differs somewhat from usual teachings, and, although based primarily upon observations made in the study of

Hodgkin's disease and allied affections, identical and, occasionally, even greater involvement has also been observed in both cancer and tuberculosis.

Neck.—In the cervical region the groups of greatest danger, because they are most commonly neglected and are of constant or frequent involvement, are widely separated. Beginning at the upper margin, glands are found within the capsule of the submaxillary salivary gland, and also above and behind that structure. Two or three glands are so constant in the lower portion of the parotid that this part of that gland should be included in all radical excisions. The mastoid lymph-gland is always dangerous. A group rather difficult of access when the mastoid muscle is retained, lies just behind its attachment and between the origin of the internal jugular vein and the trapezius muscle. Along the anterior limits, that is, in the midline, glands are so common from the submental group to the sternum that dissection must extend beyond this midline. This is particularly true in the supra-sternal region. The fat surrounding the insertions of the sternomastoid muscles is gland-bearing, and is not infrequently the pathway of extension of disease from one side of the neck to the other. Within the musculotendonous part of the lower mastoid muscle, there is a gland in a small proportion of individuals, but it is sufficiently common to demand the division of the insertion of this muscle, when its removal is indicated, as close as possible to the sternum.

The posterior margin has been a site of recrudescences after supposedly radical extirpations because a group of glands lying on the external surface of the trapezius muscle at its upper third had been neglected. Likewise a chain lying behind the anterior

margin of the muscle, increasing in numbers toward the lower end, has been overlooked with disastrous results.

The inferior boundary presents the greatest difficulties because of the necessity of blocking temporarily all lymphatic pathways leading to the mediastinum and the axilla. In front of the clavicle at its inner third lymphatics connect those of the neck and upper chest, and extend, at least under pathological conditions, into the axilla through the interval between the costal and clavicular portions of the pectoralis major. Behind the middle third of the clavicle is the most constant connection between the neck and the axilla through lymphatics lying both in front of and behind the vein. The latter are of great importance, and will be discussed later. At the outer third, preclavicular extension occurs, but is uncommon; still more infrequently there is transmission between the neck and the axilla in the lymphatics of the fat surrounding the insertion of the pectoralis minor. Extension to the mediastinum may occur either in front of or, far more commonly, indeed almost constantly, behind the deep veins. So regular is this involvement that removal of all fat from the region behind the juncture of the subclavian and jugular veins should be a routine.

The deep-lying glands in the area included within these limits are both numerous and widespread. A chain lying behind the jugular vein is constantly involved, and, as a rule, is easily removed without injuring the vein or nerves. The groups lying equally deeply, but more laterally, are possibly the most dangerous. They are imbedded in thick fat, especially farther outward, where a large group is constant and is connected with the axilla just posterior to the axillary vein and still farther outward and posteriorly

by a chain lying in the fat on the anterior surface of the subscapularis muscle. Extirpation of this gland-bearing tissue should be done regularly, even if no palpable glands are present, as they can be considerably involved under such conditions.

Technically, the dissection thus indicated, extending from above the margin of the jaw to below the level of the clavicle and from beyond the midline mesially to behind the anterior margin of the trapezius laterally, is tedious under the most favorable conditions, and when the disease is extensive and adhesions dense, it becomes exceedingly difficult. Generous incisions giving wide exposure when the skin is reflected can be variously placed. One of the Bastianelli type is the easiest to make, but gives very unsatisfactory functional results when there is any tendency to keloid or when the repair is delayed. Beginning over the base of the mastoid, cutting downward and backward an inch or more behind the margin of the trapezius, then continuing downward almost to the level of the clavicle and following the natural skin creases, thence forward to a point beyond the opposite sternoclavicular joint, will give, after a wide forward reflection of this quadrilateral flap, an abundant exposure to reach all but the submental glands. These can be secured through a small additional incision. The actual dissection is facilitated by systematic methods, which must not be too inflexible as in some individuals it is easier to excise from a direction which might be impossible in others. In general, after reflecting flaps, it is convenient to work from all margins toward the center until the eleventh nerve has been located and freed, and the internal jugular exposed. The operation indicated for the particular problem disclosed is now determined. Then, depending on whether the mastoid muscle and

jugular vein can be spared, the next steps follow in natural sequence. No important structures should be sacrificed wantonly, and usually patience and a sharp knife will bring surprising results. Two little procedures are helpful in extirpating these deep glands. The dislodgment of the fat from the deep triangular space between the clavicle and the subscapularis muscle and the ribs can be started safely with a knife-handle and completed with gauze, thus sparing important nerve-trunks. Before removing the tissue from behind the subclavian jugular angle, it is well to have the rest of the dissection along the inferior and mesial aspects completed, as there may be an anomalous vein here that is easily torn, and the consequent bleeding difficult to control unless all possible access is provided. It is not always possible to avoid injuring the thoracic duct. If it is accurately sutured or completely ligated, there is no further trouble. A leak is a sorry complication. The right duct is less troublesome, but venous bleeding on the side is equally trying to control. Heat and pressure make accurate clamping possible.

These wounds should be subjected to *x*-ray exposures at the conclusion of operation, and repeatedly thereafter. This irritation is not conducive to smooth healing; consequently a careful closure is demanded. A formation of the most complete muscle floor possible by spreading the margins of the muscles, tacking them to each other and to available fascia, more than repays the time required for its accomplishment. The obliteration of dead spaces, the covering and protection of nerve-trunks, especially the spinal accessory and hypoglossal, and the provision of a firm smooth basis with adequate nourishment for the skin-flap, really a whole thickness of graft, is thus achieved. Subcutaneous coaptation, in addition to a usual skin

approximation, is necessary. Both should be done with interrupted stitches. The best results are obtained when no catgut is used. Dressings also play an important part in the healing. The head must be held inclined towards the shoulder of the side operated on, and held securely. Large dressings make possible an even, firm pressure on the whole area of operation. If drainage is indicated, small soft-rubber tubes so arranged that they may be withdrawn after twenty-four hours without removing the bandage, are satisfactory. It is wise not to change dressings for two or three days to avoid even trifling motion. These patients usually sit up the second day, and are out of bed on the third.

Axilla.—At the beginning we wish to emphasize that, while the axillary dissection is the easiest of the three regions, repair is the most tedious if it be attempted to save the pectoral muscles, and the functional results are often less satisfactory when this is done. Moreover, a complete excision of dangerous tissue is impossible under this handicap.

The relationship of the upper margin of the axilla to the extension of the disease to and from the neck, has already been considered. Superficially, there are in addition pathways of dissemination toward the midline anteriorly leading along the perforating branches of the internal mammary to within the thorax, or, more superficially still, to the opposite side of the chest. In exceptional instances glands are to be found in the attachment of the pectoralis major muscle at about the level of the fourth costal cartilage, consequently, when this muscle is excised, it should be removed as completely as possible, for the lines of extension lie not only upon both surfaces of this muscle, but actually within it, as well as through the space between its two portions. In the deeper tis-

sues glands occur above the level of the veins so commonly that all the fat lying here upon and between the nerve-trunks of the plexus, including that about the insertion of the pectoralis minor, should be removed. The most frequent line of extension in the chain of glands lying along the lower and anterior aspects of the axillary vein, is not completely broken unless all the fat is removed from beneath the costoclavicular ligament. If the trunks of the external respiratory and the long thoracic nerves are located, as easily can be done by the overlying veins, then the entire mass of fat lying anteriorly to the subscapularis can be removed safely from a level well above the vein posteriorly and downward to the attachment of the latissimus dorsi and posteriorly well back on the serratus magnus, thus cutting off more dangerous pathways toward the spine and neck. The posterior margin of the axilla shows a constant chain of glands extending on the chest-wall along the anterior margin of the latissimus dorsi and also upon both its anterior and posterior aspects. The lower anterior axillary margin may lead to an extension of disease in the intra-abdominal epigastric lymph-glands, as well as to hepatic (Handley) involvement. The anterior axillary margin communicates under pathological conditions so freely with the opposite side as to be a constant menace. Another source of danger is the lateral segment of the female breast. Lymph-glands are found in this tissue, and, when radical operations are done for disease not intrinsically mammillary, at least the whole outer margin of the gland should be sacrificed. Direct extension through the intercostal muscles occurs when there is advanced disease high in the axilla, but only when it is so advanced that no intervention is to be considered. We contend upon these grounds that a radical extirpation for mammil-

lary cancer to be rational must include the subcutaneous fat and superficial fascia over an area extending from above the level of the clavicle down nearly to the umbilicus, from beyond the midline anteriorly, backward well behind the anterior margin of the latissimus dorsi. Virtually all of both pectorals must be included, as well as the fat above and behind the vein and backward in the hollow of the scapula. Such wounds heal splendidly, and, if the cephalic vein be spared, give better functional results than when even the costal portion of the pectoralis major is saved. This statement is based upon results obtained by different methods applied to the same individual. The reduction of edema, early and late and in the period of disability on the side operated on more radically, is definite, and the functional result is better. Under other conditions than cancer, when less radical methods are indicated, the selection of a suitable operation is extremely difficult. If the tissues beneath the pectoralis major are sufficiently thoroughly excised to justify the intervention, the process of repair is retarded by the dead space created, no matter what plastic methods may be applied to obliterate it. The problem becomes one of balance between the dangers of reduced local resistance liable through early regional recrudescences and disability. Wound-closure is along the lines indicated for the neck, and usually results in prompt superficial healing; ten days or two weeks later the deeper mischief begins to show itself. No drainage that I have been able to devise will eliminate the complication in these extensive but incomplete excisions. When the operation has been complete,—that is, a resection of all of both pectorals,—drainage is frequently unnecessary; and the healing is prompt, provided the radiation is not carried beyond the limits of resistance to this irritation.

Groin.—The inguinal region presents comparatively little difficulty. Superficially, the dangerous gland-bearing area extends slightly above the level of a line between the anterior-superior spines, below to about the junction of the upper and middle thirds of the thigh, mesially onto the adductor longus, and laterally to within the line of the anterior-superior spine. More deeply it lies mainly along the femorals and iliacs upward to the promontory of the sacrum. The only problem to be considered here is whether deep dissection is to be carried above the level of Poupart's ligament.

The line of incision is of importance, for upon it depends primary union of the skin. If made slightly to the middle side of the area indicated and curved convexly outward, the resultant healing is good. If made convexly inward, a slough is assured. After reflexion of the skin-edges the fat and fascia are removed down to the external oblique fascia above Poupart's ligament, and, beginning an inch below this ligament, the entire fascia lata is excised over the exposed area. The external cutaneous nerve and the long saphenous vein must be spared. If, in addition, the glands along the iliac vessels are to be removed, the fascia of the external oblique is incised as in a herniotomy, the lower margins of the internal oblique are retracted upward, and the peritoneum is elevated. This may be accomplished without division of the deep epigastric vessels, though usually this division gives a better exposure. With blunt dissection, clamping resistant bands before dividing them, removal of fat to the sacrum is accomplished with surprising ease and without shock. The very limited bleeding is easily controlled with heat and pressure. Drainage is contra-indicated. In closing this artificial hernia, it is well to imbricate the fascia of the external oblique so that the lower margin is outside and

may be stitched as high as possible to get this line of sutures well above the dangerous area just below Poupart's ligament. The muscles exposed by the excision of fascia lata can be spread, dislocated, and stitched so as to cover important nerves and to make a fairly complete floor for the skin to lie upon and from which to get an early blood-supply. The importance of saving the long saphenous vein lies in the fact that the redevelopment of lymphatic vessels is thereby facilitated. Wounds of patients thus operated on heal surprisingly well, and after a few months such patients are without edema, even after prolonged standing. When the excision is bilateral, a trying edema above the symphysis pubis and in the external genitalia is persistent. In these inguinal operations also it has been our experience to find the introduction of catgut a guarantee of suppuration. Skin-closure should be as indicated for the neck as the effect of the ray must also be safeguarded.

CONCLUSIONS

The criticism has been made so often that surgery is contra-indicated in many of these affections at any stage, and in all at later stages, that we wish again to emphasize certain points in the morbid physiology concerned, which, we believe, uphold the affirmative viewpoint since they have been confirmed by results obtained.

Early in these diseases, while they are limited in extent, proper surgical procedures effect a complete subtraction of the particular process concerned, as is evidenced by permanent recovery. Somewhat later, but while the resistance is still high, extirpation approximately complete may lead to the same fortunate result. Still later, operative reduction of the amount of disease, however radical it may be, will of itself promote not more than a temporary improvement. It

may no longer be claimed that the treatment of these diseases, however early it may be instituted, is completed in the operating-room. It has only begun there, and must be continued intelligently and accurately if each individual is to receive every opportunity to recover.

This squares with the conception that certain processes are malign for certain individuals because those individuals are incapable of responding to the irritant in question with a sufficient excess of local and general resistance. While it is possible, though improbable, that some form of passive immunity may later be developed to supply this deficiency, certain it is that no form of curative vaccination has an element of justification for its use.

Progress can come only by an exact application of sound therapeutic measures in nature and in sequence dependent upon a growing knowledge of the living pathology of the disease and the morbid physiological responses it stimulates. Universal therapeutic failure and the testimony of the post-mortem examination are evidence that prophylaxis and therapy have been at fault usually because the pathology was neglected, and not because the disease was incurable.

The opinion expressed by W. J. Mayo (Mayo, W. J.: Ann. Surg., 1916, lxiv, 304-310) must come to be accepted as the basis of judgment of methods of treatment whose value is dependent, not upon the immediate mortality-rate in incipient cases, but upon the larger proportion of recoveries produced in the more advanced cases. Moreover, successful palliation, a material prolongation of life in hope and comfort, is perhaps as worthy an achievement as effecting a recovery and is as urgent a therapeutic obligation, not only from the patient's standpoint, but also because of

the progress in treatment that can be made in no other way.

DISCUSSION

Dr. E. Starr Judd (Rochester, Minn.): We are deeply indebted to Dr. Yates, as well as to Dr. Bunting, of the University of Wisconsin, who was associated with him in his valuable work on Hodgkin's disease. I believe it is altogether the most valuable work that has ever been done on Hodgkin's disease.

I have had an opportunity to see some of the patients Dr. Yates operated on. He showed five or six patients at the Clinical Society in Chicago apparently cured by these very radical operations, and the follow-up treatment as he has described. I believe the very radical features of these operations contribute largely to success. So many of us when operating and finding Hodgkin's disease previously have taken out a few glands that are accessible, and then stopped right there, thinking it hopeless to proceed. It is only when a radical operation is done,—that is, taking out the muscles, vessels and nerves,—that anything like satisfactory results can be obtained. In these operations upon the neck the sternocleidomastoid, and the larger muscles can be removed and the functional results will be good. The internal jugular vein can be sacrificed without much, if any, consideration, as long as it is done on one side at a time. In the block dissections everything except the vagus and common carotid may be taken out with good functional results. The same way, in the axilla; the fascia, with the pectoral muscles, and then the axillary veins may be removed. We have taken out the axillary vein five times without any more swelling than in the ordinary axillary dissection. Surgery of the axilla may be very radical and there will be good function still.

I am sure, we are all very greatly indebted to Dr. Yates for this work.

Dr. M. L. Harris (Chicago): I want to say just a word or two in commendation of the excellent work which Dr. Yates and his colleagues have been doing in the past few years in this group of what has been heretofore considered hopeless cases. We have all passed up a group of cases under the name of Hodgkin's disease that have gone on to certain death. There now seems to be considerable light thrown on this subject by the work of the gentlemen mentioned.

I have likewise had the pleasure of seeing a number of these cases in which the most extensive dissections have been made; and, to all appearances, what were previously apparently hopeless cases have turned out to be, clinically at least, cured. I feel that we owe Dr. Yates and his colleagues a debt of gratitude for the persistence with which they have followed up this work, and for the excellent scientific way in which they have gone at the subject.

Dr. Arthur Holding (New York City): With your indulgence, I can tell Dr. Yates why these flaps break down. In our experience in treating lymphatic tumors and carcinomas with radio-active measures we have found that flaps break down because the rays roughen the endothelial linings of the capillaries which nourish the flaps, producing endarteritis obliterans; a slough results, and we have a trophic ulcer.

Dr. Yates mentioned the ray as an important factor, and I am glad that he emphasized this. In the discussion of Dr. Percy's paper on the treatment of carcinoma of the breast nothing was said concerning the importance of using post-operative raying. This is an important point of technic because by raying we can make tumors of lymphatic glands disappear. In the accompanying diagram this action is explained (illustrating). We make the tumor disappear because the ray acts upon the nucleus, stopping its division, blocks off the capillaries of the blood supply by causing the endothelial lining to swell. This leads to degeneration of the cells, because these cells are nourished by capillaries. The tumor cells are thus inhibited and starved, resulting in degeneration and death. The space once filled by the tumor becomes occupied with detritus and connective tissue, instead of the tumor.

If the blood supply is from vessels large enough so that they have three coats, we cannot get enough roughening of the endothelium to block the vessels off or thrombose them. After the tumor has disappeared, if you cut out the site of the tumor and make serial sections of this tissue you will see that, while you have made the tumor disappear because of the ray's action on the nucleus and endothelial lining of the capillaries, right next to the blood-vessel wall, which was too large to be obliterated, you will occasionally find the viable tumor cells. If you use enough radio-activity to kill these resting tumor-cells you will kill the patient. This gives us a hint as to the best technic to employ in raying operative cases of tumors of the lymphatic system, carcinoma of the breast, etc.

On the day before the operation I give just as large a dose of the ray as I dare, in order to make the nuclei sick at the time of operation, so that, if any are spread in the tissues, they will be less malignant. On the following day at the operation when the wound is wide open one can give three or four times as much *x*-rays as would be possible were the treatments given through the skin. Therefore with the wound open, have the Coolidge tube in position, and give a large dose right into the wound. As soon as the patient recovers from the effect of the operation and can leave her room, treat any remaining microscopical cancer cells by raying the mediastinum from all sides through the unincised sound skin, through the back and from the other side of the body than that on which the operation was performed. Why should we begin so soon? Because, if you are ever going to effect cures with the ray on tumor cells, you will succeed only when you apply the rays before the cells have established their blood supply with three-wall blood-vessels formed in stroma. You will succeed in killing the tumor cells only when they have capillary blood supply. You can obliterate capillaries easier than you can full-formed blood-vessels. Do not let your carcinoma cases go until you can feel metastases; hit with the *x*-rays just as soon as you can.

One more point: When we treat these carcinomas of the breast with the ray, we do not get a return on the side that the tumor was removed from, as a rule. Incisive and radiologic surgery controls the local recurrence on the side operaated on. These cases are frequently treated with *x*-rays only on the side where the tumor was. From an experience gained by watching a large number of these cases we have learned that they are prone to develop breast carcinoma on the other side, which means that you must treat these cases with the rays on both sides.

THYROID DISEASE AND THE PRESENT METHOD OF OPERATIVE TREATMENT

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There has been much study, of late, upon the thyroid in order to determine its true function, the character of the toxic substance for which it is responsible, the symptoms present in the diseased state, and the influence of this substance upon the various tissues of the human body.

Some data have been secured to formulate definite rules of procedure in the treatment of the diseased thyroid. All such study and data up to the present time indicate that operative treatment is the most reliable and gives the most permanent results, and also that the symptoms of thyroid disease must be recognized earlier by the profession in general, and the gland operated on to prevent irreparable damage to the heart, liver, kidneys, nerves, and muscle tissues of the body.

Ligation of the blood supply is performed quite extensively in severe cases; and in other less toxic cases a rapid removal of one lobe or portions of both lobes is made or a resection is done with the removal of the center and the more diseased portion of the tissue in the lobes, allowing the capsule of the posterior half of the gland and any healthy glandular structure attached thereto to remain. The latter plan has been followed by satisfactory results; and a symmetrical

neck with a moderate degree of scarring is thus obtained.

Myxedema will not be considered in this paper, nor will the unusual types, such as intrathoracic or aberrant goiter.

The etiology of disease of the thyroid is yet unknown, but many facts are being brought out clinically and from laboratory experiments which point more and more to a possible infection as the main factor in bringing about a perverted function of the gland, and that this infection may come from diseased tonsils as pointed out by Shirley, from the colon as suggested by Lane, in intestinal stasis, or from impure or contaminated food or drinking-water, as is the belief of a large number of observers. To quote Wilson and Kendall: "Assuming the same toxic substance to be the cause of all thyroid intoxication, the factors involved to produce the varying clinical pictures are the daily amount of absorption of the toxic substance, the length of time during which this intoxication occurs, and the personal resistance of the patient."

Kendall has obtained what he terms Alpha iodine from the thyroid which, when given in 1-60 grain doses daily for a few days, produces symptoms of exophthalmic goiter, namely, tachycardia and nervousness; and it has been shown that the substance is found in much less quantities (1-5 to 1-200) in the exophthalmic type, which suggests the possibility that the thyroid has lost its power to retain the toxic substance which is liberated in the system and produces such profound disturbances, or that the gland is overactive.

There may be some change in the gland which destroys the retentive properties of the gland.

Clinically, goiter has been usually classified as the

simple and exophthalmic, but Plummer has chosen to classify them under *hyperplastic toxic, non-hyperplastic toxic,* and *non-hyperplastic atoxic.* The first group resembles the exophthalmic type, and the last is of the simple variety; the second, the non-hyperplastic toxic, is very chronic in its course, patients sometimes suffering from it for sixteen or eighteen years. In the hyperplastic type there seems to be more or less constant delivery of toxins into the circulation, while in the non-hyperplastic these toxins are delivered more intermittently. The various classifications may, however, represent but a certain stage in the development of the disease, if we are to consider that all thyroid disease is due to the same cause.

The symptoms vary according to the form of the disease affecting the thyroid and the stage at which the disease is observed. In the simple, mild form few symptoms may be observed to attract one's attention to the goiter, at which time a careful process of exclusion will have to be followed to eliminate possible complicating conditions, such as toxemia from intestinal stasis, and chronic local infection, from teeth or tonsils. In the graver forms of the disease, where there are more disturbances of the gastro-intestinal tract, the symptoms may be so confusing that one may be led to believe it a case of intestinal toxemia, an aggravated form of colitis, or even gastric ulcer, when there is vomiting of blood.

In acute hyperthyroidism, disturbance of the nervous system is particularly noticed, while in the chronic form there is more apt to be found a degeneration of tissues with damage to the heart and kidneys.

The symptoms may abate for a time, and the patient remain fairly free from toxic disturbances until they recur under some exciting cause.

When the heart is dilated or the kidney or liver substance is affected, these tissues are not usually restored to normal, even after an operation. Wilson has pointed out that the so-called fatty degeneration which takes place in certain tissues of the body is really fatty infiltration, which fat takes the place of the normal tissue. He is uncertain whether the poison affects the muscles directly through the circulation or through the nerve ganglion controlling the muscular activity.

Ochsner believes that in a thyroid with exophthalmic symptoms there is unmistakably hyperplasia in some portion of the gland.

"The hormone relation of the suprarenal and the thyroid and that epinephrin stimulates the thyroid has been quite clearly demonstrated by Cannon, who also says, 'it is not unreasonable to suppose that the thyroid gland has an emergency function, acting in critical times, which would seem to increase the speed of metabolism when the rapidity of the body processes might be of the utmost importance, and, besides that, augmenting the epinephrin which would be secreted simultaneously.' "

Shirley says that acute hyperthyroidism may be aborted by early removal of diseased tonsils, coëxisting with the thyroid disease. Lane states that many cases of thyroid toxemia and enlargement of the gland will subside by overcoming an intestinal stasis.

Unquestionably, some goiter symptoms will disappear under medical and hygienic treatment; therefore, it is advisable to institute this line of treatment for a time at least in certain cases.

Von Rehn first discovered that operation cured exophthalmic goiters. He has had many followers since, each trying to improve the technic and lessen the mortality-rate.

Porter states that "the coëxistence of either nephritis or diabetes with hyperthyroidism should be considered rather as an argument for than against operation." It should be the rule to remove all permanent goiters, whether they are producing symptoms or not; and were this rule followed there would be fewer cases of toxic goiters. "There is as much reason for removing so-called simple goiters with a view of preventing them from becoming toxic as there is for removing or curing by surgical means certain lesions, such as warts, moles, and chronically inflamed areas to prevent them from becoming malignant."

The goiter of adolescence may contain the potential elements of a serious condition, and no doubt many of them should be operated on early to remove any colloid or retained gland secretion, cysts, or adenomatous tissue. The degeneration which takes place in these cases, in after-life, may be an over-production of fibrous tissues, cysts, or calcareous deposits.

Diseased thyroids have been removed under local anesthesia. Kocher is a great advocate of this plan, and believes there is less shock, less traumatism, less hyperthyroidism, and less pain and injury to the nerves while operating under local anesthesia. A number of operators give ether up to the beginning of the operation, and then withdraw it until the operation is completed. Ether is the universal anesthetic, and is very satisfactory and safe in the simple cases.

The average child needs one-third the total thyroid, and the average adult will not be inconvenienced from the loss of five-sixths of the gland, providing the remaining portion is healthy; therefore, it is best not to remove all of the thyroid unless it is necessary. In certain types, however, where there is a probability of malignancy occurring, it is best to remove all the lobe affected.

Porter in severe cases of hyperthyroidism substitutes boiling water for ligation.

The point to be determined, when operation has been decided upon, is how much to do, whether to ligate one or more arteries, to remove part of one lobe, part of two, all of one, or all of both. The question must be decided by each individual operator in each particular case in hand. A time should be selected when the patient is at her best, and then we may expect a cure in from 40 to 60 per cent of the cases. The chronicity of the case with moderate or pronounced symptoms, and the destruction already produced in the body tissues, will determine whether operation will really be of benefit or not. In the majority of cases there may be a time, between the exacerbations of the symptoms, in which an operation may be undertaken with the least possible risk; and when Crile's system of "stealing the goiter" can be inaugurated, operative shock will be slight. I believe, as we become more familiar with the early symptoms of goiter, unless some specific serum treatment is discovered, that operation will of necessity be performed earlier, with the result that some of the 5 to 10 per cent who die without or in spite of an operation, may be saved; also that fewer ligations and more complete resections will be instituted with more permanent results secured thereby. We shall, therefore, shorten the preparatory period for, and the convalesence period following, the operation.

De Quervain ligates the inferior thyroid artery some distance away. He uses the collar incision through the skin, fat, and platysma. In two hundred cases in five years there was no tetany following operation. There is a possibility of injury to the sympathetic nerve by the retractor; however, De Quervain is in doubt as to the number of arteries to be tied,

as the parathyroids may be destroyed, the blood supply being cut off. A collateral circulation for the gland from the neighboring organs is partly supplied, even after the exclusion of all other arteries. The posterior branch of the superior thyroid and isthmus he believes sufficient for the blood supply.

In America the low collar incision is usually chosen, as it lessens the probability of a great scar. This should be symmetrical and sufficiently long to take out the tumor beneath. The skin flaps are then dissected upward and downward from the underlying structures, and the bleeding points ligated. A median perpendicular incision is made through the fascia between the sternohyoid and the sternothyroid muscles. The thyroid capsule is observed, and, if the lobes are not too large, they are carefully brought out through this wound. This can be done in nearly all instances without any appreciable hemorrhage. When the lobes are very large it may be necessary to cut the muscles transversely and on a higher level than the skin incision. The lobes are either removed or resected according to the various recognized modes of procedure or the individual operator's technic.

The writer has somewhat modified the usual technic of goiter operations in cases that require a complete exposure of the thyroid area by passing clamps from a lateral punctured wound through the muscles and fascia tissues toward the center of the neck, the handles of the clamps being thereby out of the way and the flaps held away by a retractor for thyroid operations. The superior and inferior arteries supplying the blood to the lobes are ligated with double No. 2 plain catgut with one surgical knot, so that it may later be tightened after the diseased portion of the lobe has been removed. The ligature includes part of the healthy glandular tissues at the upper and lower

poles. The central portion of each lobe is then removed by a shelling-out process, which should include all the diseased portion of the lobe, leaving the posterior half of the capsule and the healthy glandular structure attached thereto. We should be careful to leave an equal amount of healthy glandular tissue on the respective sides. If there is considerable oozing a long, curved, and flexible clamp approximates the sides and controls bleeding. The sutures at the poles are pulled tight, and a second tie made. These sutures should have a round-curved needle on one end sufficiently long to finish the approximation and stop bleeding. The lower is utilized to approximate the remaining portion of the gland and capsule, by a running Halstead through the capsule and glandular substance and tied to the loose end of the suture controlling the blood supply at the upper pole, from which point the end of this suture holding the needle is started continuing in an over-and-over manner approximating the edges of the capsule, thereby controlling all oozing, and at last tied to the loose end of the suture controlling the blood supply at the lower pole. The opposite lobe is operated on in like manner. (See illustration.)

Any enlargement of the isthmus is similarly treated, only the diseased portion is cut away from the trachea. The respective lobes are now dropped back of the muscles, which are sutured together, including the fascia, with fine chromic or plain catgut. The skin is sutured with a subcutaneous chromic catgut, and a drain extended down to the lower part of the remaining thyroid.

Certain patients with pronounced toxic symptoms will not recover by an operation, nor will they improve when the heart has been constantly rapid (120 to 160), especially if there is a systolic murmur or mitral

Fig. 1. Eight months after operation.

Fig. 2. Six months after operation.

Fig. 3. One year after operation.

Fig. 4. One year after operation.

Fig. 5. Mother fourteen months after operation, daughter two months after operation.

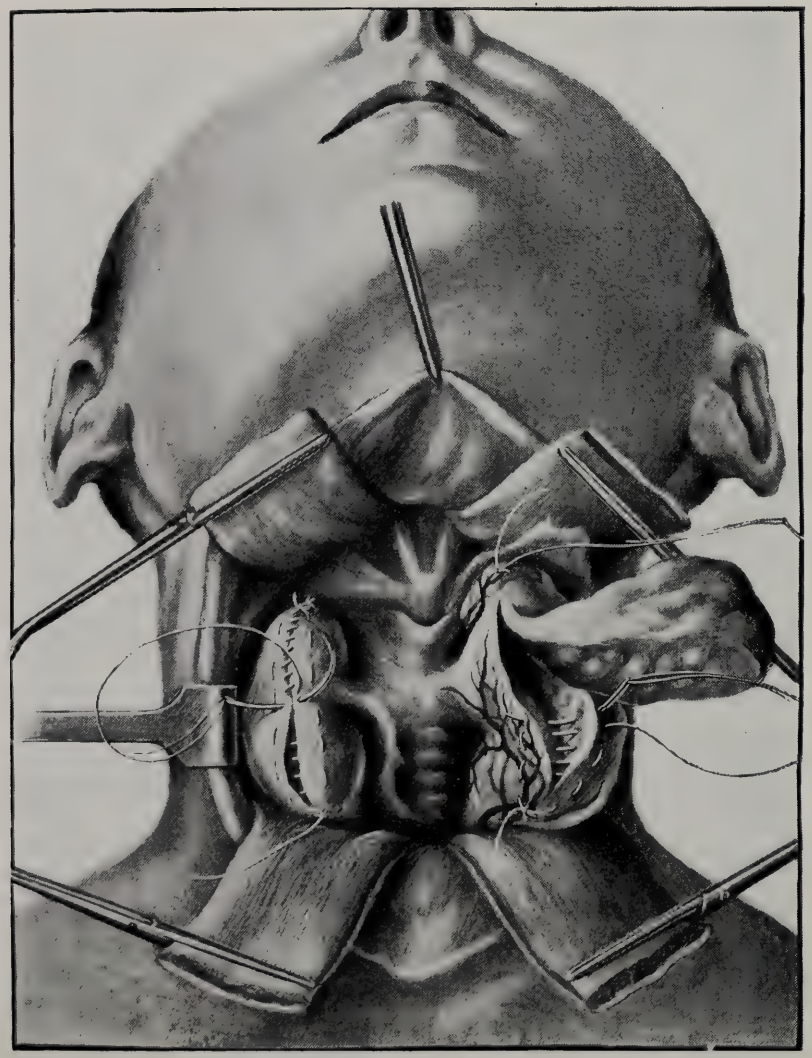

Fig. 6. Ligating and resecting the thyroid.

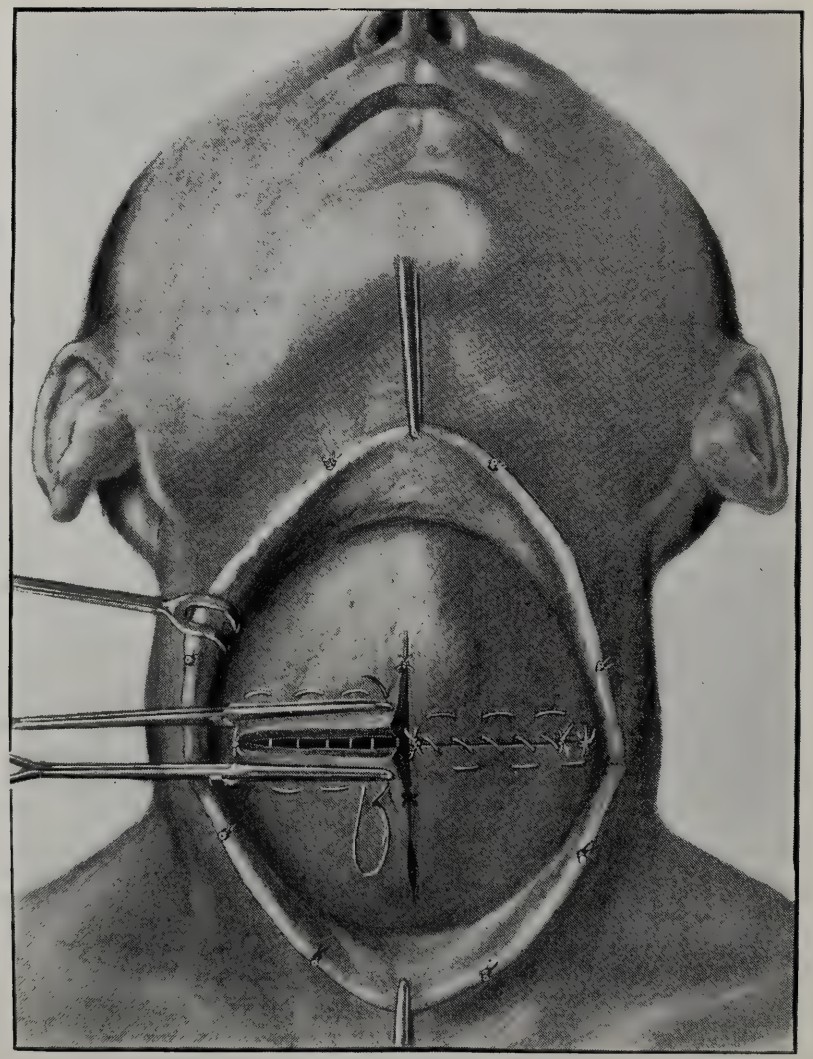

Fig. 7. Closing muscle and fascia.

regurgitation with restlessness, anxiety, or mania. Inability to retain food with vomiting of blood is a very unfavorable symptom. Positive involvement of the kidneys with albumin and casts is occasionally present. The condition may resemble one of cerebral tumor or meningitis. I have seen a few patients with these pronounced symptoms, and none have recovered, with or without an operation. In fact, I believe it is unwise to operate on any of these patients in the toxic stage.

Judd and Pemberton, in a paper read before the Southern Surgical and Gynecological Association in December of last year, reported a series of one hundred and twenty-one patients, dividing them into five groups, who had exophthalmic goiters, and in this report emphasized the fact that all deaths occurring directly following an operation were in cases operated upon at the maximum severity of the disease. The belief of most surgeons of the present day is, that acute hyperthyroidism, if present when operation is performed, frequently results in death; therefore, we now select the less toxic stage of the disease for operation. Judd concluded from this series that exophthalmic goiter cure may be expected in 45 per cent, that 23 per cent are practically cured, 4 per cent receive some benefit, and 5 per cent receive no benefit.

Vernon C. David reports in sixty-five patients operated on for exophthalmic goiter from 1905 to 1914, 38 per cent were cured and 40 per cent were greatly benefited.

Of the thirty-five patients having exophthalmos before the operation, only thirteen, or 37 per cent, reported themselves relieved of it.

The duration of symptoms before operation in the patients cured was sixteen months, in those greatly

benefited it was twenty-three months, and in those not improved it was thirty-three months.

Dr. C. H. Mayo puts the immediate mortality of exophthalmic goiter at 3 per cent, and the relapses at 10 per cent.

From statistics gathered from experienced operators in thyroid disease we might conclude the immediate mortality in simple goiters is almost nil; and, since the toxic goiter is apparently a sequence of the more simple form of the disease, the profession in general should learn to recognize the cases requiring operations before serious complications arise, and advise the operation before a severe form of hyperthyroidism occurs.

When an operation is performed upon the surgical goiter at an early stage a removal of all of the diseased tissue is possible. It is then performed in the minimum amount of time with no shock, leaving a symmetrical neck but little scarred; and a permanency of the cure is more likely to follow.

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DISCUSSION

Dr. Arnold Schwyzer (St. Paul): Dr. Benjamin has spoken of the etiology of goiter, and has mentioned infection. In this connection I think the work of Farrant, of London, is most interesting. He had made a good many autopsies, and innumerable experiments on animals; and he found that each different kind of bacterium had a different effect upon the goiter. He found that most of the ordinary pathogenic cocci, staphylococci, streptococci, and pneumococci made practically no changes, but other organisms, such as the bacilli of diphtheria, anthrax, and dysentery made enormous and rapid changes in the thyroid, just exactly like the changes that we have in exophthalmic goiter,—acute cellular hyperplasia with acute absorption of the colloid. In other cases he found he had only colloid hypertrophy, a diffuse colloid hypertrophy, which corresponded with the milder toxic forms. It thus would seem that there is a gradual transition, and that may be taken as an excuse of the doctor for not making a sharp enough distinction between the treatment of exophthalmic goiter and the ordinary toxic non-exophthalmic goiter, and even the simple forms of goiter. In the treatment, that makes, however, an enormous difference. We know the special dangers of exophthalmic goiters, and how they ought to be treated, and that when feasible as much as possible should be removed, say, four-fifths or nine-tenths; but, if we have a combination of ordinary goiter upon which exophthalmic goiter is secondarily implanted, we must see that we get the real hyperplastic parts removed. It may be in this country we do not lay as much stress on not removing too much in the simple goiters. In the simple colloid goiters, especially in older people, we are liable to have a deficiency of the thyroid afterward. So we remove the most degenerated nodular parts, and leave the best parts especially near the trachea, often the isthmus.

Dr. Benjamin has shown us excellent results, but the technic he has described is for uncomplicated cases. I should like to hear something, for instance, about intrathoracic goiters.

I remember one patient who very nearly died on the table before starting the operation, and before we could do anything we had to incise the trachea, and use a long flexible cannula, which I introduced clear down to the bifurcation. It was marvelous how freely I could then manipulate the goiter below the jugulum without interference with the respiration.

We had two goiters which reached down to the second rib, and we got them out. If the dyspnea is severe in the intrathoracic goiters, it is necessary to have a long flexible cannula. Ordinary intubation-tubes cannot be used. Intubation may be impossible, when the larynx is too far drawn down by the goiter.

Dr. Leonard Freeman (Denver): I again desire to call attention to a simple and safe method of performing partial thyroidectomy which I have been using for a number of years with much satisfaction.

The lobe to be operated on is exposed, and dislocated through a collar incision in the usual manner. A wire tourniquet is then placed around the base of the lobe in the way I am able to demonstrate to you upon this rubber sponge.

Two wires are prepared, as in the illustration, with their sharp ends bent over to prevent injury to gloves or tissues. On one of the wires are securely tied three long loops of strong cord (heavy fish-line, for instance), one in the center and one at either end. By means of small alligator forceps, the free ends of the loops are then drawn through the substance of the base of the lobe, one through either end, and one through the center, and the other wire passed through the three loops. When the loops are now cut and tied tightly the two wires are firmly clamped against the base of the gland, and act as a tourniquet, the constriction being rendered still more secure by winding the long ends of the two outer loops around the extremities of the wires which project beyond the gland, as seen in the illustration. Half knots are usually sufficient, which easily permit further tightening at any time if desirable.

With a sharp scalpel the portion of the gland beyond the tourniquet is then removed without fear of hemorrhage or of injury to the nerves. It is like cutting a piece of cheese.

Permanent hemostasis is secured by whipping over the raw surface with a continuous catgut suture, after which

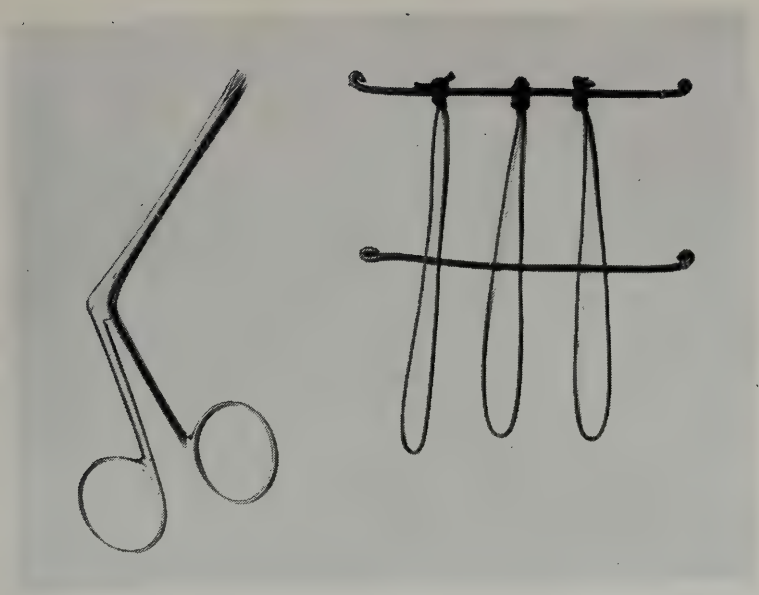

Fig. 1

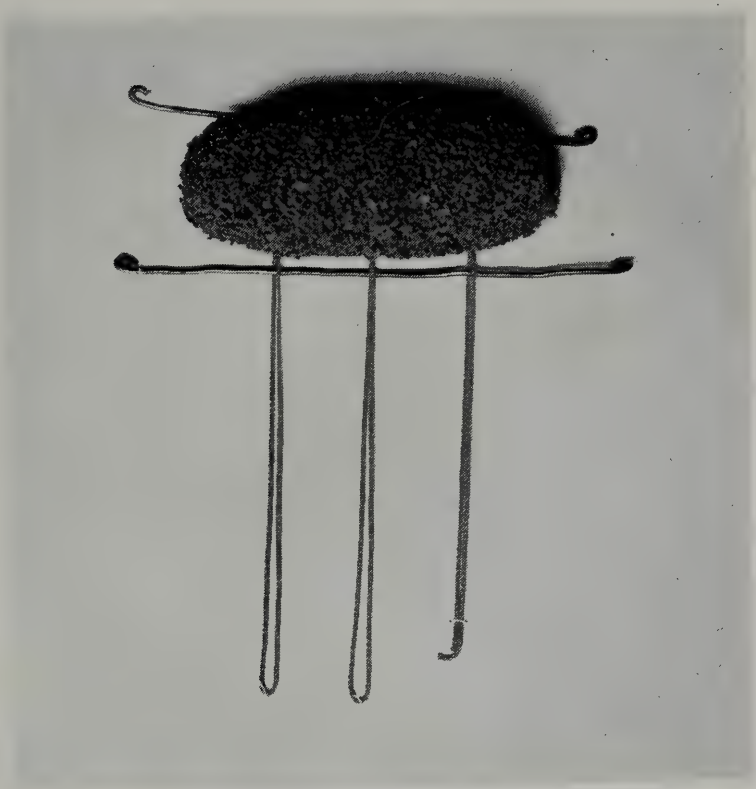

Fig. 2

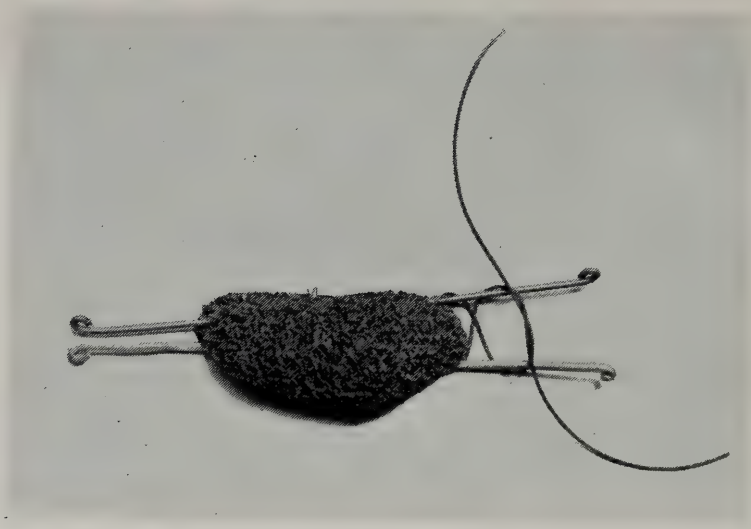

Fig. 3.

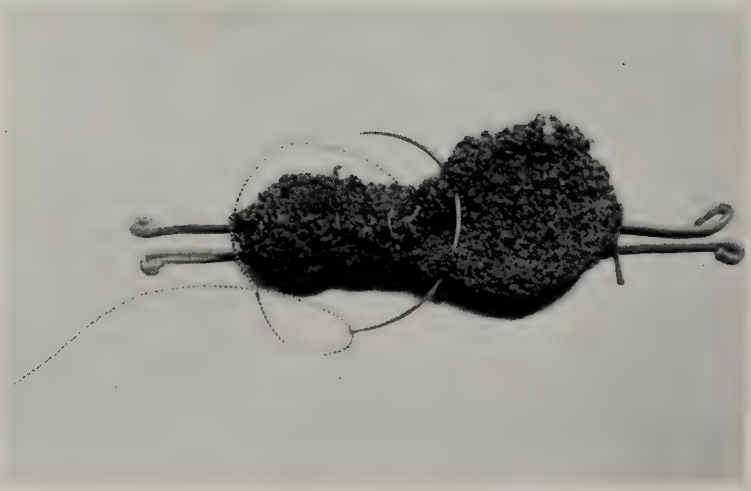

Fig 4.

(The preceding four cuts illustrate points in Dr. Freeman's discussion on Dr. Benjamin's paper.)

the wires are removed by dividing the loops which bind them together. It is seldom necessary to tie any vessels, not even the thyroids themselves.

The advantages of this method are several:

1. The rapidity with which it can be done.

2. The absolute control of all hemorrhage, venous and arterial, from the isthmus, as well as all other sources, this control being manifestly more thorough than is Dr. Benjamin's method.

3. The small amount of room occupied by the wires and the impossibility of their slipping off when the projecting lobe of the gland is cut away, as is quite liable to occur with forceps.

4. The great unlikelihood of injury to the recurrent laryngeal nerve or the parathyroid bodies. Even if these structures were caught in the grasp of the wires, which is extremely unlikely, the pressure is not great enough to permanently injure them. With forceps, on the other hand, if they are locked tight enough to prevent slipping, they are more than likely to injure the nerve or parathyroids if they happen to grasp the one or the other.

5. The wires do not crush the gland as do forceps, which is perhaps of some importance, especially in exophthalmic goiter with hyperthyroidism.

6. The wires may be bent to accommodate themselves to any sort of goiter, even when the dislocation is incomplete. They can be used easily when forceps could be employed only with difficulty.

Wires can be used upon goiters of all sizes and consistencies unless extensive calcification is present.

Their value is particularly noticeable in the soft, mushy vascular goiters, so often encountered in the exophthalmic form, and which bleed so readily and profusely when not expertly handled.

(See illustrations on the accompanying inserts.)

Dr. Benjamin (closing): I am very much obliged to Dr. Freeman for bringing out this ingenious method of dealing with these goiters. He no doubt had the same idea that I had in establishing an operation of this sort: first, to limit the number of forceps which we usually see applied in these cases, as the average operator has from ten to fifty forceps attached to the tissue in and around the wound, and it re-

quires, of course, a great deal of time to apply these forceps and to tie vessels which are clamped; secondly, not to cause injury to the tissues back of the capsules,—the parathyroid and the recurrent laryngeal nerve. In order to prevent injury of these structures I first operated by the use of flexible clamps applied above and below, using a similar method to that described by Dr. Freeman, only using the ordinary flexible clamp, like a stomach-clamp, that does not crush the gland at all. In this manner, you grab the upper and lower poles, and control hemorrhage completely. I would rather employ this sort of a method for the reason that frequently we find, in operating in these cases, a cyst or adenoid located anterior to the posterior capsule lying on the trachea. In this manner you have the two flaps of capsule lying open; you can then scoop out the diseased interior of the thyroid. The best part of the thyroid tissue lies next to the capsule; the inside or center is usually the portion we wish to get out. I first used one large clamp in clamping the whole lobe, something like that of Dr. Freeman's, but I find by using two curved clamps I can accomplish this much better. In the last six or eight months I have been using nearly altogether the ligature because I find there is not so much traumatism, it saves time, and you have the same sutures you can continue suturing with.

I must say there are some cases in which I think this ingenious method of Dr. Freeman would apply to better advantage. Personally, I think that goiter operations have been made too difficult, and it was with the idea of making it as simple, as safe, and as easy an operation as possible, that I attempted the procedure I have described, and in order that we may see exactly what we do. We then applied the forceps in this manner to the fascia and muscle, and it is remarkable with what ease and safety we can go after these bad goiters. I have seen experienced operators have difficulty in controlling hemorrhage. They have perspired a great deal over these cases.

My goiter operative work has been pleasant since I have adopted this method.

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Milwaukee

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